BOARD OF AGRICULTURE AND FISHERIES.

LEAFLETS

(Nos. 1 to 100)

SIXTH EDITION.

LONDON:
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,
BY DARLING & SON, LTD., 34-40, BACON STREET, E.

AND TO BE OBTAINED AT THE OFFICE OF THE BOARD OF
AGRICULTURE AND FISHERIES, 4, WHITEHALL PLACE,
LONDON, S.W.

1906.

Price Sixpence.

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The Board of Agriculture and Fisheries think it may be convenient that the first hundred of their leaflets should be re-issued in book form, so that agriculturists and other persons may more easily keep them for purposes of reference.

The leaflets will continue to be issued singly, and copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped. The Board hope that those who possess a copy of this volume will make the existence of the leaflets known to all to whom they are likely to be of practical interest.

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(2.) List of Leaflets in alphabetical order—*cont.*

BOARD OF AGRICULTURE AND FISHERIES.

The Black Currant Mite (*Phytoptus ribis*).

Fig. 1. Bud Mite, greatly enlarged. Fig. 2. A normal currant twig. Fig. 3. Currant twig with infested buds. Fig. 4. Eggs of Mite, greatly enlarged.

This mite has been found on black currant plantations in nearly all parts of the country, having evidently been transmitted from place to place with cuttings and young black currant bushes. Its presence is detected by the distortion of the buds (Fig. 3). In many cases it has been necessary to grub up the black currant bushes and to replace them with other kinds of fruit bushes, as the infestation advances with such rapidity that the continued cultivation of this fruit has been threatened in some localities.

Upon examination with a microscope it is seen that the unnaturally swollen buds are full of whitish mites which are feeding within the whorls of the embryonic leaves and blossoms. The buds become swollen by the

irritation set up by the mites, and can produce no leaves or fruit. In some few cases stunted leaves may be put forth, which fall off in the early summer, but no blossoms or fruit are formed from such infested buds.

It is somewhat remarkable that the old-fashioned and original variety of black currant is comparatively free from this attack, but this is a bad cropping variety, and has generally been replaced by more prolific kinds. In one case reported where two sorts of currant trees were mixed together, one a short bushy kind, the other tall and straight, it was found that the diseased buds were almost entirely confined to the former; and on examining samples of the two varieties the one badly infested with *Phytoptus* was recognised as the "Black Naples," and the other, which was entirely free, was "Ogden's Black Grape," a variety with much longer stems, and with its buds farther apart. The Baldwin is most subject to the attack of the bud mite.

Life History.

The black currant mite belongs to the sub-family *Phytoptidæ*—gall-mites—of the order *Acarina.* There are very many species of these. One seriously injures pear trees, another is found abundantly upon lime trees, while filbert, apple, peach, plum, alder, maple, yew, willow, and other trees have their respective species. The *Phytoptus vitis* is found extensively upon vines, and it has been found that the raspberry has its special mite, which has been described as *Phytoptus rubi.** Other trees and many other plants have their peculiar varieties of *Phytoptus.*

The *Phytoptus ribis* is indistinguishable with the naked eye, but it can be seen with a pocket lens. It has four legs, which are short, and of nearly equal length. At the extremity of each of the legs there is a very fine feathered bristle and a single claw, and a couple of simple bristles. The snout is short. The body is cylindrical, and, according to Nalepa, has 70 rings. At the tail end there is a pair of long bristles, and three large pairs on the back of the body, and two small pairs, as shown in Fig. 1. These appear to help locomotion, or to steady the mite in its movements, which are very slow.

Eggs are found in the buds nearly all the year round. The eggs are more round than ovoid in shape, and are colourless and very abundant. The mites stray about upon the shoots when the buds shrivel up, and make their way into the cavities at the bases of the leaves, and finally into the embryonic buds. In some cases, probably, they fall to the ground and may get upon the shoots which come up from the stocks of the black currant bushes.

* *See* Report on Insects and Fungi injurious to Crops, 1892.

Frost has apparently no effect upon these mites. During hard frosts they have been seen actively at work in the centre of the buds, though there had been from 15 to 18 degrees of frost during the week, and the buds were hard frozen when examined.

Modes of Prevention and Remedies.

When black currant bushes are planted they should be carefully examined for any indication of infestation. This is plainly demonstrated by the unnaturally swollen buds. If these are found, the bushes should be rejected. And in taking cuttings in the autumn those from infested bushes should by no means be planted. Though there may be no swollen buds the mites may be in the buds or upon the cuttings in the folds of the rind.

Infested bushes should be pruned very hard, and every particle of the cuttings carried away and burned at once. The bushes on 10 acres on a Kentish fruit farm were very badly infested in 1893, so that it was almost decided to grub them up. They were, however, left and pruned very hard in 1893 and 1894. In the spring of 1895 there was plenty of wood and but very few swollen buds, and a good crop of fruit was grown. After hard pruning, the bushes should be looked over, and any abnormally swollen buds upon them picked off and burned. In small plantations and gardens hand-picking might take the place of severe pruning, but in large plantations it would be too expensive.

Little good can be done in regard to remedies. The fumigation with hydrocyanic acid, as largely used for scale attack abroad, has not met with the success which was at one time thought likely. Further experiments may, however, show it to be useful as regards the cleansing of young plants. *The best plan for growers to adopt is to cultivate from clean stock only.* Clean stock can be obtained with a little trouble, and growers should insist that all cuttings are from non-infected plants.

Dipping the plants in hot water has also been tried experimentally with some success, but not enough is yet known to recommend the treatment.

4, Whitehall Place, S.W.,
April, 1894.
Revised August, 1901.

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BOARD OF AGRICULTURE AND FISHERIES.

Vine, Plum, Hop, and Raspberry Weevils.

The weevils included under the above heading comprise (1) the Black, or Vine Weevil (*Otiorrhynchus sulcatus*, Fab.), (2) the Clay-coloured, or Raspberry Weevil (*Otiorrhynchus picipes*, Fab.), (3), the Red-legged, or Plum Weevil (*Otiorrhynchus tenebricosus*, Herbst.), and (4) the Ivy and Hop Weevil (*Liophlœus nubilus*, Fab.). Other species do damage, but the four named are the most abundant.

These weevils frequently do much harm to many plants and trees, among which may be noted vines, mangolds, peas, beans, young turnips, strawberries, raspberries, plums, cherries, peach and nectarine trees, ferns and flowers of various kinds in pots and in borders, in greenhouses, and in the open air. In 1894 the first two of these weevils were unusually troublesome ; the hot dry summer of 1893 appeared to be most favourable for their increase. Hop plants are sometimes seriously injured by them, mainly, however, by the clay-coloured species (*O. picipes*), and the ivy and hop weevil (*L. nubilus*), though occasionally the dark-coloured species (*O. sulcatus*) is found on these plants. The hop bines flag, their heads droop just after they are tied to the poles, and they have deep punctures here and there. In some cases these punctures are so deep that the bines are nearly cut in two, just as the tender shoots of vines are treated by the vine weevil, and the juicy sprouts of raspberry canes by the first three species.

Besides the damage done to hop plants through the leading shoots of the bines being cut off and so weakened as to be practically useless, the "hills," or plant centres, are much injured by the grubs, or larvæ, which feed upon them during the late autumn and winter. This injury has been attributed to wireworms in many cases. The roots are especially damaged by the grubs of *O. picipes*, which burrow into them and soon cause decay.

Strawberry growers have often experienced much loss from these beetles in the weevil form, and more particularly in the grub or larval stage. The grubs burrow into, and feed on, the roots and crowns of the plants from September until March, and after April the weevils pierce the shoots and runners.

Gardeners who find flowering-plants, such as dracænas, cinerarias, cyclamens, primulas, spiræas, sedums, and others, withering or dying in greenhouses and borders, should search among the roots for the white grubs of the weevils. If the young succulent shoots of vines are found to be pierced and nearly severed, it is certain that there are weevils in the soil near the vine stems, and action should be taken against them.

Peach, nectarine, apple and pear trees are frequently injured by weevils, which bite their shoots and cause the sap to escape just when it is required for the fruitlets.

The Black, or Vine Weevil.

(*Otiorrhynchus sulcatus*, Fab.).

Fig. 1.

Larva 1, 1*a*; pupa 2, 2*a*; weevil, 3, 3*a*; natural size and magnified.

This weevil is termed *sulcatus* because of the broad, deep furrow on its rostrum. It is about two-fifths of an inch long, black, with greyish hairs upon the head and thorax, having reddish antennæ with clubbed apices, and dark coloured legs. The elytra have somewhat deep furrows with a few yellow hairs. No wings are present.

Eggs are laid in the summer, and the grubs, or larvæ, are found, from the early autumn until March, in the earth near to, and among, the roots of plants. The larva is creamy white, without legs, curved in the position shown in the figure, and has many brownish hairs upon it. The pupal state is assumed in the early spring, and according to Taschenberg lasts 14 days. The pupa is yellowish-white in colour, and is covered with reddish hairs, but is without

a cocoon. It is found at a depth of from 2½ to 4 inches in the earth. When the weevil emerges, it at once attacks the plants near it, feeding only at night. When disturbed, it feigns death, and remains immovable for a long time. It is tenacious of life in an extraordinary degree, and in its weevil state disregards heat, cold, and the most pungent odours. Curtis says that nothing but boiling water and turpentine seems to annoy this insect.

The Clay-coloured, or Raspberry Weevil.

(*Otiorrhynchus picipes*, Fab.)

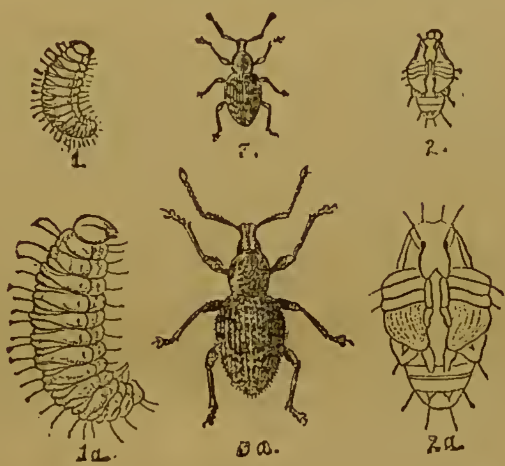

FIG. 2.

Larva, 1, 1*a* ; pupa, 2, 2*a* ; weevil, 3, 3*a* ; natural size and magnified.

The clay-coloured, or raspberry, weevil varies from one-fourth to a little under one-third of an inch in length. Its head and thorax are of a pitchy colour, and the elytra somewhat brown, but these are thickly covered with light-coloured scales, which make the weevils of the colour of clay, so that it is impossible to detect it in clayey soils. These scales seen under the microscope appear like beautiful mosaic or tessellated work. The weevil is rather ovate in form, and has dark-red or pitchy-red legs, as Schönherr describes them, with pitchy 12-jointed antennæ furnished with clubs. The femoral teeth, as Schönherr notes, are very indistinct, and in many cases imperceptible. There are long bristles upon the rostrum, and rows of short bristles down the furrowed elytra. This insect has no wings, and is a night feeder.

The life history of this weevil is practically the same as that of *Otiorrhynchus sulcatus*. Eggs are laid in the summer in the earth. The grub, or larva, is white or yellowish white, thickly covered with hair, with a brown head, but without feet. It lies in a curved position, and feeds

on roots throughout the autumn until the spring, when it changes to a whitish pupa with black eyes, from which in about a fortnight the weevil comes.

The Plum, or Red Legged Weevil.

(*Otiorrhynchus tenebricosus*, Herbst.)

This weevil is one of the most destructive to plum, raspberry, strawberry, cherry, apricot, nectarine, and peach in the London district and the South and South-East of England, especially on chalk soils. The beetles strip the shoots of their leaves, destroy the buds, and even attack the bark, and their larvæ devour the rootlets and roots of the strawberry, &c. during the winter. In length the plum weevil, so-called because of its apparent partiality for plum foliage, varies considerably; the usual size is about half-an-inch long, but small specimens may be found two-fifths of an inch long. It is black and shiny, the wing-cases with lines of punctures, and in quite fresh specimens some ashy-grey scales; the legs are dull red. Like the other two it is mainly nocturnal in habits. The eggs are laid just under the ground: they are at first white, but become jet black in two days; they hatch in August and September, and the larvæ, which are very similar to the two former species, remain feeding upon strawberry and other roots until the following March or April. The pale, brownish-white pupa is found in an earthen cell, and remains in that state from fourteen to twenty-one days. The pupæ are found, as a rule, about 2½ inches beneath the surface. This weevil is apparently double hooded.

A closely related species (*O. fuscipes*, Walton) also works in a very similar way.

The Ivy and Hop Weevil.

(*Liophlœus nubilus*, Fab.)

Several reports of the damage caused to hops by this weevil have been received from growers in Kent. It varies considerably in size; small males occur only one-third of an inch in length, some females as much as three-fifths of an inch long. In colour it is black, densely covered with ashy-brown scales, the wing-cases with small tessellated spots and punctured lines; the legs are dark, and rather hairy. This weevil lives in hedges, on various young trees, on ivy and other plants. It damages hops by biting the bine, especially

attacking the tender shoots. Like the *Otiorrhynchi* it works at night, hiding between the bine and the pole or in the earth of the "hills" during the day. It frequently becomes covered with the earth, in which it hides. Nothing seems to be known of its life history.

Preventive and Remedial Measures.

As the weevils described above feed upon many trees and plants, it will be found that they often come from hedgerows round fields cropped with hops, peas, beans, mangolds, turnips, or fruit bushes, and gradually infest these crops. In some hop gardens in Kent they spread from rows of poplars planted as shelters, or "lews," for the hop plants. In others they came from raspberry and currant plantations near. As they cannot fly, their progress is slow, and they should be prevented by active measures from advancing in fields where they are discovered. They may be caught upon hop plants and raspberry plants by holding tarred boards near the ground at night, and tapping the poles or stakes so that the insects fall into the tar. Some hop planters send men with lanterns to pick them from the hop bines at night. In this way many weevils may be caught.

They would be disturbed by prong-hoeing close round the plants, and hoeing in lime and soot mixed together. A constant moving of the soil with nidgetts, horse-hoes, and hand-hoes, would tend to check the progress of the weevils in the case of hops, mangolds, peas, beans, and turnips. In infested hop-land and fruit-land, where the plants are permanent, besides constant hoeings and the application of caustic materials in May and June, when the weevils are active, the soil immediately round the plant centres and bushes should be treated in the autumn with lime and soot, or earth, sand, sawdust, or ashes saturated with paraffin oil at the rate of from four to five pints to a bushel.

In strawberry fields it is most difficult to cope with these insects, but when infested fields are grubbed up they should not be replanted with strawberries for two or three years.

Strawberry plants in gardens that have become infested with weevils should be examined closely in the late autumn, and the grubs picked out from the roots as far as possible.

In regard to strawberries, one point of importance to notice is that the beetles seek shelter beneath which to deposit their eggs, and this is readily found under the straw or grass put between the rows to keep the fruit from the earth. In all cases the straw should therefore be put on as late as possible and cleared away as soon as the fruit is gathered.

With regard to vines in houses, the weevils may be trapped at night with tarred boards, or cloths spread under the vines or they may be picked off them. The roots of flowers in

pots can be easily freed from the grubs, and if there is an attack on flowers in borders their roots and the soil near them should be examined and the grubs picked out. Where peach, nectarine, and other wall fruit trees are attacked, the walls should be kept free from holes, and often white-washed; the base of the wall thickly tarred, and ash and tar spread along the foot of the wall. The tarred boards may also be used at night, or the weevils may be picked off by hand.

Natural Enemies.

These weevils, although not materially checked by them, have several natural enemies. Amongst the most important are the so-called sand wasps, or *Odyneri*. These wasp-like insects provision their nests with the adult weevils, which they apparently paralyse with their sting, and upon which the larvæ in their nests feed when hatched. One species (*Odynerus parietinus*) has frequently been observed carrying off the smaller of these weevils, and another hymenopteron (*Cerceris arenaria*) often does the same.

Blackbirds and thrushes also devour them.

4, Whitehall Place, London, S.W.,
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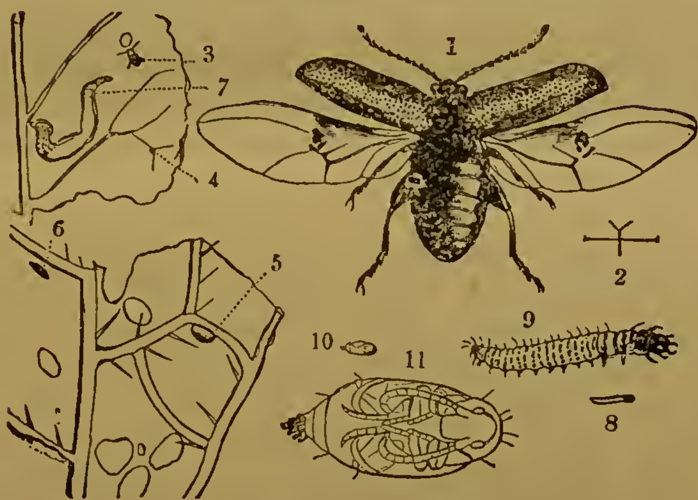
BOARD OF AGRICULTURE AND FISHERIES.

"Flea" Beetles (*Halticae*).



1. The Turnip Flea Beetle, much magnified; 2, nat. length and wing expanse; 3, nat. size; 4, 5, egg, nat. size and mag.; 6, 7, mine, and cuticle eaten away by larva; 8, 9, larva, nat. size and mag.; 10, 11, pupa, nat. size and mag.

Flea beetles attack all manner of crops; roots, cabbage, and hops being most harmed.

The Turnip Fly or Flea (*Phyllotreta nemorum*) and the Cabbage Flea (*Haltica oleracea*) are small beetles which thrive in dry, dusty, and cloddy soil, and in dry seasons cause much harm to turnip, cabbage, kale, and other plants, which cannot grow away from their attacks. Directly the seed leaves show, the young plants are eaten off, or, if they continue to grow, they are in most cases so weakened as to be practically useless. Other closely related species work in a similar way. In conditions favourable to the propagation of the beetles, they increase with great rapidity; generation succeeds generation, clearing off every particle of growth as it appears. The beetles do not flourish in showery weather, and as this suits the turnip plants, it is chiefly in times of drought that most damage is done. In such seasons, turnips have often been sown three times, each crop being successively cleared off.

Though the main and most dangerous attack of these beetles is undoubtedly when the plants are just starting, and until they are fairly in the strong "rough leaf," it is by no means unusual in periods of drought to find that even if the

plants manage to grow away from the first onslaughts, they are so steadily and constantly beset by the insects, and their leaves are so much bitten, that they never make good roots. When the roots are formed, and are of some size, late generations of beetles pertinaciously stick to them, in some seasons even until September. The turnip flea-beetles not only attack turnips and swedes, but are sometimes destructive to rape, mustard, cabbage, kohl-rabi, and other cultivated cruciferous plants.

Quite as harmful, if not more so, is the Cabbage Flea (*Haltica oleracea*); in some districts it is the chief culprit, the so-called Turnip Fleas only appearing in small numbers. Whole cabbages may even be destroyed by the Cabbage Flea. Hops are often ruined by these pests, the young shoots and also the cones being invaded.

Description and Life History of the Beetles.

The Common Turnip Flea (*P. nemorum*) is very small, being only about one tenth of an inch long. It is black, bluish-black, or greenish-black in colour, with a broad yellow stripe down each wing-case. The antennæ are 11-jointed, the three joints nearest the head being yellow, the others dark-coloured. The legs are ochreous, or yellow, and the thighs, which are very stout, are well adapted for the long jumps which this insect can make. Like all flea beetles, it passes the winter in beetle form under clods and stones, in tufts of grass, among weeds, beneath the bark of trees, and under rubbish of various kinds, by the sides of fields, hedgerows, and ditches. It is thus sheltered during the winter, and it is sustained throughout the early spring-time, until the turnip seed has germinated, upon wild cruciferous plants, such as charlock, hedge-mustard, and wild radish. It has large and powerful wings, expanding to more than a quarter of an inch (Figs. 1 and 2), and takes long flights in search of congenial food, which it scents from a distance. In its feeding it shows a preference for the seed leaves, and for the plant in its youngest stages, *e.g.*, when the plant is most delicate and least able to withstand injury. The beetles lay their eggs on the under sides of the second or "rough" leaves. From these eggs, tiny yellow larvæ come in five or six days (Figs. 8 and 9), which, mining (Fig. 7) in the leaves, and feeding upon the soft tissues, greatly weaken the plants. When full grown, the larvæ are rather more than $\frac{1}{8}$ of an inch long, with six feet and a caudal proleg, or "sucker foot." In the course of from five to seven days, they fall to the ground and change to pupæ (Figs. 10 and 11), from which, in about 12 days, the perfect beetles come and proceed to attack the turnip-plants. It is said that as many as six generations may be produced in a season, if weather and other conditions are favourable.

P. undulata, an allied species, is often also very troublesome on the turnip crop ; it is slightly smaller than *nemorum*, and has dark-coloured legs.

The Cabbage Flea (*Haltica oleracea*) is often far more harmful than the Turnip Flea ; in some districts it is the chief root crop and general pest. It is of a deep bright bluish-green colour. This species feeds mainly on the upper side of the leaves, and attacks old and young plants, especially cabbages, but also turnip and other crops. Unlike the Turnip Flea, it does not make holes in the leaves, but eats the upper epidermis and soft under layers, leaving the lower skin intact. The female lays her eggs on the surface of the leaf, and the larvæ feed *upon* the leaf. When mature the larvæ pupate in the soil like the Turnip Flea. The beetles do not seek shelter so readily in inclement weather as the Turnip Flea, but remain upon the leaves of the plants. The great difference to be noticed here is that the maggots do not burrow into the leaves, so can be destroyed by arsenical washes. It is thus important to note which of these two common flea beetles is doing the damage.

Methods of Prevention and Remedies.

1.—Sowing upon a "stale furrow" is calculated to prevent the attacks of these beetles. A stale furrow usually implies a "good season," or a fine tilth or seed-bed, whereas fresh-ploughed land does not usually work down well, but is unkind and cloddy. Moisture also evaporates more quickly from land that is cloddy, or rough, than from fine tilthy soil. The beetles do not like moisture, and moisture naturally helps the young plants to grow away from their foes.

2.—Rolling the land after the drill should be adopted, as this assists germination and gets rid of clods underneath which the insects shelter.

3.—Artificial manure mixed with well-powdered ashes, or mould, may be drilled in with the seed so that it may be close to the plants to help them to grow as quickly as possible away from the onslaughts of the beetles.

4.—Putting in seed with a water drill has certain advantages on some soils where the beetles are known to be particularly troublesome. An objection to the water drill is that the moisture soon evaporates in a dry season, and though it starts the germination of the seed rapidly, this is liable to be checked and the vitality of the seed injured unless rain soon comes.

5.—Cruciferous weeds, such as charlock, encourage the beetles and furnish them with food until the turnip plants are ready for them. It is desirable, therefore, that charlock and other cruciferous weeds should be kept down.

6.—The destruction of winter shelter as far as possible is very important. Hedge bottoms should be cleared in winter, and the refuse burnt, and all refuse where these pests are

likely to pass the winter should be got rid of. Broken bine lying about in hop gardens should be collected and destroyed.

7.—In some seasons sowing mustard seed with turnip seed preserves turnip plants from serious injury, as it germinates and forms plants more quickly than turnip seed, but in very dry times, when the attack is virulent and generations of beetles follow rapidly, this has been found of little value. The beetles do not take to mustard plants in preference to turnip plants, but being ravenous, they attack the mustard plants, as they come up first.

8.—Seed should be soaked in paraffin or turpentine before being sown. The latter answers best, and is usually found to keep "fly" away from the seedlings for some little time, and may perhaps, apart from the beetle attack, produce an earlier and more vigorous growth. Mixing the seed with flowers of sulphur is also recommended.

9.—Paraffin oil may be distributed in very small quantities over the seedlings, so that each leaf is sprinkled and made distasteful to the beetles ; for this special spraying machines must be used, so as to send out a fine dense spray. In a case where, experimentally, sand or sawdust steeped in paraffin was spread on the drills, not only were the young turnips more vigorous in their growth, but they were also protected against a small Ceutorhynchus beetle which attacks the seed-leaves before these get above the soil.

10.—Rolling infested plants, by disturbing the beetles, frequently proves serviceable, especially if the soil is cloddy.

11.—Pushing by hand a light wide framework upon wheels with well tarred boards fastened upon it, so as to come just over the plants, has been found to catch many beetles, which, being disturbed, jump against the tar. Many acres can be got over in a day by a horse pulling this machine, which should be made very light. The tar requires to be renewed as it gets dry, and the beetles, which accumulate in masses, must be scraped off. Cart grease may be used instead of tar.

12.—In the case of Cabbage Flea and other *Halticae* where the larvæ feed on the *outside* of the leaves, spraying with Paris green would be found successful by killing the larvæ ; on the other hand, it would be useless for Turnip Flea, as the maggots feed within the leaves.

4, Whitehall Place, S.W.
July, 1895.

Revised, July, 1905.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Winter Moths.

FIG. 1.

FIG. 2.

Fig. 1. Winter Moth (*Cheimatobia brumata*). Fig. 2. Great Winter Moth and Caterpillar (*Hibernia defoliaria*). Male Moth, winged; Female Moth, wingless. All natural size.

There are several moths whose wingless females crawl up the stems of fruit and forest trees in the autumn and early winter and spring and deposit eggs in the interstices of the rind of the twigs and branches. From these eggs caterpillars are hatched in the spring which bore into buds and eat the leafage and blossoms, and young green shoots, and, in conditions favourable to their development, cause much injury to the fruit crop. Among these moths the Winter Moth (*Cheimatobia brumata*) (Fig. 1), and the Mottled Umber, or Great Winter Moth (*Hibernia defoliaria*) (Fig. 2), and the March Moth (*Anisopteryx aescularia*), are the principal offenders. In some seasons, especially in those when the progress of the leaves and blossoms is arrested by spells of cold weather, great mischief is caused by the caterpillars of these and other moths, the females of which are wingless. Sometimes the trees are left as bare as in winter, and are, besides, seriously injured for another season. The caterpillars attack apple, plum, damson, filbert and cob-nut trees, and occasionally currant and gooseberry bushes that are set under apple and plum trees in fruit plantations. They are also harmful in woods, feeding on the hazel, maple, hornbeam, lime, and oak.

Description and Life History.

About the second week of October, the two Winter Moths come from chrysalids in the ground, under and near the trees that were infested with caterpillars in the preceding

summer, and the wingless females crawl up the trees for the purpose of egg-laying.

The Moths.—The male of the Winter Moth measures 1 to 1¼ inches in spread of fore-wings. These are grey-brown in colour with darker wavy lines. The hind wings are pale grey and are without markings.

The female moth has the wings so small that flight is impossible. The abdomen of the female is large and the legs long.

The Great Winter Moth is about twice as large as the Winter Moth. The male has the fore-wings pale brown or brown-yellow, each with two dark bands. The hind wings are paler and have a brown spot near their middle. Small dots show over the wing surface.

The wings of the female are practically abortive; the brown body has two dark spots on every segment.

The antennæ of the male are combed, those of the female simple.

The Eggs.—The eggs of the Winter Moth are very small, cylindrical, and at first of a light green colour, afterwards becoming red. They are placed in small groups, usually at the bases of buds and on pruned surfaces, sometimes in the chinks of the rind of the branches and shoots, and fastened there with a sticky substance. From 150 to 200 eggs are laid by one female. The Great Winter Moth lays larger, rather rusty coloured, long eggs, and more in quantity (as many as 400), which are placed in lines, or small groups, according to circumstances.

The Caterpillars.—From the eggs the caterpillars come in the early spring, usually about the middle of March, and, as it appears, just before the buds begin to burst. The Winter Moth caterpillars are at first grey, with dark heads, and so small that it is difficult to see them. Later on they become greenish, with white stripes and brown heads, and are finally rather yellow. When full grown they are about three-quarters of an inch long. They, as well as those of the Great Winter Moth, are called "loopers," or "measurers," on account of the position they assume when moving. They have six true legs, and only two pairs of prolegs, one pair of these being at the hind end of the body, so that they can be easily distinguished from caterpillars of other moths. These larvæ eat bud, leaf, blossom, and fruit, and spin the blossom heads, and also the leaves, together, and live under their protection. When food fails, or when they are fully fed,—from May to June—they let themselves down by silken threads to the ground, in which they bury themselves. The moths of both species begin to appear in the first week in October, and may be seen throughout November and December, and even in January and February—depending on the weather.

The caterpillar of the Great Winter Moth is chestnut brown in colour, with a wavy dark stripe on each side of the brown ; there is a tinge of yellow on the under part of the body. It is much larger than the Winter Moth caterpillar, being 1¼ inches in length (Fig. 2). These caterpillars, too, have the habit of letting themselves fall from the twigs, to hang by a silken thread. When the period of pupation arrives the caterpillar descends to the ground and changes to a chrysalis just below the surface.

Methods of Prevention.

1.—It is very necessary to adopt methods of prevention against these insects. The first and most important of these is to prevent the wingless female moths from crawling up the trees in the autumn and winter months. This can be effected by putting sticky compositions round the stems to entrap the moths.

Cart grease made from fat or oils, and without tar, is recommended as the best and safest composition to use for banding fruit trees. In all cases the grease must be spread on bands of grease-proof paper. These bands should be 6 inches wide, and tightly tied to the tree above and below by a piece of string. The bands are best placed four or five feet above the ground. If the trees are young and stakes are used, the stakes should be banded also.

Grease-banding must be commenced early in October, and the grease renewed from time to time when the composition has become dry and hard. If stout paper be used it may last for two years.

It will be necessary to keep the bands in good working order as long as moths are seen about.

In February or March, or as soon as frosty weather has gone, the wingless females of some other species of moths, *e.g.*, the March Moth (*Anisopteryx aescularia*) come forth, and ascend the trees for the purpose of laying eggs upon them. These other moths are not nearly so numerous as the Winter Moths, but it is necessary to keep the bands in working order for them also in some districts ; it is desirable upon the breaking up of winter to observe whether the male moths are flying about the trees in the dusk, and, if they are seen, to put the bands in working order at once.

2.—In the case of cultivated fruit land, many of the chrysalids might be destroyed by digging or hoeing late in the summer the ground all round trees that were infested in the spring, and by digging or hoeing in lime or gas-lime.

3.—In grass orchards, the herbage should be close-fed off by sheep. Poultry should always be kept in orchards, for they devour many larvæ, and also the female moths as they

escape from the ground. Many fruit growers also recommend pigs, which help to keep the trees in a comparatively clean state by destroying insects in the ground.

Remedies against the Caterpillars.

Spraying trees with arsenites is always necessary. Small apple, plum, and damson trees, filberts, cobs, and fruit bushes can be easily sprayed by means of proper knapsack sprayers. Large trees beyond the reach of hand sprayers can be sprayed with hop-washing machines, but there are machines especially manufactured for this purpose.

Only arsenical sprays are of any use against the caterpillars. Two of these sprays are strongly recommended, viz., Paris Green and arsenate of lead.

Paris Green costs from 10*d.* to 1*s.* per lb. It should be obtained in the form of paste, which is safer than powder, and used at the rate of 1 lb. to from 200 to 280 gallons of soft water, according to the age and conditions of the leafage and the kind of tree sprayed. It must not be used too strong or the leaves will be burnt. As Paris Green does not dissolve the mixture must be kept constantly agitated so that it may be maintained of an uniform strength.

Arsenate of lead is prepared as follows :—Dissolve 1 oz. of arsenate of soda in warm soft water, and add to 12 gallons of soft water. Then dissolve 3 oz. of acetate of lead in water and add to the 12 gallons of liquid. To this 1 lb. of treacle may be added.

It is not advisable to spray with arsenical solutions when the trees are in blossom, unless the attack is very severe, or bees may be killed. As the object is not to dislodge the caterpillars, but to poison their food, the arsenical solutions should be made to fall like gentle mist upon the leaves, fine spray jets being used for this purpose.

Live stock may be kept in orchards where arsenical compounds have been used. Such compounds must not be used where gooseberries for early picking, and herbs and vegetables for early use, are grown under the trees.

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Leaflet No. 5.

BOARD OF AGRICULTURE AND FISHERIES.

Mangold Fly (*Pegomyia betæ*,* Curtis).

1. Male, magnified.
2. Male, natural size.
3. Female, magnified.
4. Female, natural size.
5. Larva, natural size.
6. Larva, magnified.
7. Pupa, natural size.
8. Pupa, magnified.

Serious injury is often caused to mangold plants in June and July by the attacks of the fly, *Pegomyia betæ*, whose larvæ, or maggots, form burrows within the tissues of the leaves, and live upon the juices, weakening and exhausting the plants, and sometimes killing them. After the mangold plants have been singled and begin to show vigorous growth, they sometimes suddenly droop and present a withered appearance. Upon examination, it will be found that there are pale blotches, like blisters, upon the leaves, caused by maggots lying within their tissues, from which they have exhausted the juices. These discoloured patches become brown and withered.

Description of Insect.

The fly is about the size and shape of a common house fly. It is dark ashy grey, with black bristly hairs. The under surface of the abdomen of the male has four black triangular basal spots in the middle of four segments; the female has three indistinct stripes along it. The legs are bristly. The femora (thighs) of the female are yellow, as are also the tibiæ, or middle joints of the legs, in both sexes.

The egg is oval, white, and covered with six-sided markings.

The larva or maggot is about a third of an inch long, with undefined, or indistinctly marked segments. In colour it is

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* Formerly called *Anthomyia betæ*.

creamy white, somewhat transparent, so that the green food in the intestinal canal is visible. It has no legs. Its tail end is cut square, but the head is sharp pointed, and furnished with a pair of hooked appendages which serve for boring and cutting into the tissues of the leaves.

Life History.

The fly is seen from March to June. The female deposits her eggs singly, or in groups of two, three, or four—rarely more—upon the under surface of the leaves of the mangold plants as soon as they appear above ground. When two or more eggs are laid together they are placed side by side.

Maggots come out from the eggs in about five days, and immediately bore their way through the epidermis into the central leaf tissue, on which they feed.

The maggot stage continues for about a month, and during this period the insect does active mischief. Pupation is assumed either in the leaves, in which case the red, or reddish-brown, puparia may be seen embedded in the blisters caused by the maggots; or the maggot falls to the ground and pupates therein. From these early puparia the flies emerge in about ten days.

There are two broods during the year. The maggots of the second brood become pupæ in the ground, or in decaying leaves and similar material, and in this puparium stage the winter is generally passed. From these puparia the first brood of flies issues in the spring.

Remedies.

1.—In the first place, infested plants should be top-dressed with nitrate of soda and common salt, put on at the rate of from 1 to 1½ cwt. of nitrate of soda and 2 to 3 cwt. of salt per acre. This will force them on and give them a chance to grow away from their enemies.

2.—Washing the plants with an emulsion of paraffin oil and soft soap and water has been adopted with some success. This is made by mixing paraffin and soft soap together in the proportion of 1 gallon of paraffin and half a pound of soft soap to 10 gallons of water, thoroughly incorporated by means of a hand-pump or syringe. This composition can be put on by means of a horse-machine for the distribution of liquid dressings in the form of spray. A knapsack-machine would be found useful for applying liquids in the case of small holdings.

When the eggs are discovered upon the leaves of mangold plants in infested fields, it would probably do good to apply paraffin and soft soap washes at once to make the foliage unpleasant to the maggots when they are hatched, and thus prevent them from burrowing into the leaves.

3.—Where some of the plants in mangold fields are very seriously attacked, exhibiting many blisters and blotches, they should be pulled up and destroyed, so as to prevent a second brood of flies from being hatched and spreading further mischief. Where the plants are less affected the leaf-blotches only may be removed and destroyed. Women or children could do this work, but they would require careful instruction and direction. It need hardly be said that the plants pulled up must be completely destroyed, either by burning them or by putting the leaves in pails of hot lime.

Prevention.

a.—All the leaves of mangold plants in infested fields must be carefully collected and destroyed after the roots have been lifted. On no account should the leaves stripped from infested crops be taken into pastures for cattle during the summer, as is sometimes the custom.

b.—Many weeds, as some of the thistles (*Carduus*), sow-thistles (*Sonchus*), dandelion (*Taraxacum*), and "Fat Hen" or "Goosefoot" (*Chenopodium album*), upon which the eggs of this fly are frequently found, serve as harbours for this insect, and should be kept from the neighbourhood of mangold fields.

c.—In some localities dock leaves are frequently full of the maggots of a *Pegomyia*, which appears to be *Pegomyia betæ*, and it would be wise to wage war against this weed, and to cut it up at once.

4, Whitehall Place, London, S.W.,
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BOARD OF AGRICULTURE AND FISHERIES.

Voles and their Enemies.

The Board of Agriculture and Fisheries believe that it may be useful that some of the information contained in the Report of the Departmental Committee on Field Voles (Scotland), C. 6943, should be reproduced in a more convenient form for distribution. Among the vermin whose excessive multiplication, under specially favouring circumstances, results in injuries to farmers, the field vole was conspicuous in 1892 by the extensive damage which it inflicted on young grass and herbage, on hill grazings and rough pastures of southern Scotland. This animal has proved a source of much loss on former occasions in other parts of the country, as in Essex and Kent three hundred years ago, in Gloucester and Hampshire early in this century, and again in Scotland in 1875-6.

With the following extracts from the Report of the Committee, some of the illustrations given in that Report have been reproduced for the readier identification of the animals mentioned. As will be observed from the first of the appended plates, the characteristics of the field vole are a blunt rounded muzzle, short ears, and a short hairy tail. These features distinguish it from the true field mouse, or long-tailed field mouse, which has a pointed muzzle, prominent ears, and a long naked tail. The water vole, or water rat, differs in the same respects from the common brown or Norway rat.

Most of the animals described as preying upon the field vole are likewise natural enemies of mice and rats. Thus weasels, stoats, foxes, rooks, crows, ravens, sea-gulls, kestrels, owls, and buzzards are all known to prey upon these vermin.

The animal which caused so much mischief on many hill farms in the southern uplands of Scotland in 1892, although often spoken of as a mouse, is technically known as the short-tailed field vole (*Microtus*, formerly *Arvicola, agrestis*) (PLATE I.). Two species of the genus *Microtus* inhabit this country, viz., the water rat (*M. amphibius*) and the field vole (*M. agrestis*). The red or bank vole belongs to another species, *Evotomys glareolus.*

All three voles are distinguished from the true mice (genus *Mus*) (PLATE II.) by their stouter body, thicker head, obtuse muzzle, small ears, and the tail shorter than the body, whence they are often called short-tailed mice. Their molars, or back teeth, have flat crowns, with transverse ridges of enamel, adapted for grinding the vegetable matter on which they feed, whereas in true mice they are covered with points or tubercles suitable for an omnivorous diet.

The field vole (*Microtus agrestis*) is at all seasons an inhabitant of our pastures, and may be found at all heights, from the sea level to near the summits of our highest hills; but its favourite haunts are low-lying moist grass lands and damp plantations, especially when young. In such spots, and more frequently in the former, these animals live in communities, forming numerous burrows at a great depth, each pair having their own dwelling in which they bring up their young, and deposit their store of winter food. All around, their tortuous runs are seen on or near the surface, showing where they have been foraging.

The field vole usually produces three or four litters a year, each consisting of from four to eight young; but in some seasons it is even more prolific, the breeding season being prolonged from February to November, and the litters containing as many as ten young.

Its diet is principally herbivorous, consisting of roots, grass, and the tender bark of trees and shrubs. It particularly affects the delicate white stems of grass and rushes rising immediately out of the earth, but in times of scarcity nothing green comes amiss to it. When pressed it is said to devour insects, and even its own kind.

The Water Vole or Water Rat (*M. amphibius*) devours the stems of grain, grasses, &c., growing near water, and it also barks the exposed roots and base of stems of shrubs and trees, notably the ash, sycamore, and varieties of laurel. The water-vole also damages the banks of rivers, canals, and dykes. It lives along the borders of streams or almost any piece of water, also in damp meadows, and tunnels long passages into the soil. This vole is blackish-brown on the back with greyish-brown belly.

The Bank Vole (*Evotomys glareolus*) occurs chiefly in and around forests and woods, being especially fond of sheltered banks, ivy-clad tree stumps, and the exposed roots in banks. Not infrequently it does considerable damage to trees. It climbs to the height of ten feet or more, and eats out the terminal and lateral buds, its action resulting in the formation of mis-shapen stems. The bank vole is brownish-red with a pure white breast, belly, and feet; the ears are longer than in the field vole, coming well above the fur. It varies

in length from $3\frac{1}{2}$ to 4 inches, while its tail reaches $1\frac{3}{4}$ inches. It is not difficult to catch by means of traps baited with cheese.

One of the greatest and most effective enemies of the field vole is the short-eared owl (*Otus brachyotus*) (PLATE III.). This bird, which is distributed over almost every part of the globe, is a normal winter immigrant to these islands, appearing simultaneously with the woodcock (whence it is popularly known as the "woodcock" owl) and usually departing in spring. Nests in ordinary seasons are of comparatively rare occurrence in Great Britain, but on occasions when there has been a multiplication of their favourite food, the vole, these owls have not only arrived in unusual numbers, but have remained and bred all over the affected district, laying from 8 to 13 eggs, and rearing more than one brood. Professor Newton, however, in his edition of Yarrell's "British Birds," mentions seven as an unusual number of eggs, and five seems a general clutch.

The short-eared owl differs from most other owls in that it hunts in daylight—hence one of its names "Hawk" owl—so that its beneficial operations can be observed, but the nocturnal species are no less beneficial to farmers in destroying small rodents, and it would be difficult to condemn too severely the foolish and cruel action of those who encourage or allow the destruction of this useful and beautiful family of birds.

Next, and hardly inferior in merit, as a check upon voles and mice, comes the kestrel (*Falco tinnunculus*) (PLATE IV.), and it is to be deplored that popular ignorance as to its food and habits is even greater than that which prevails in regard to owls. This bird, although possessing the long wings and dark eyes characteristic of a true falcon, is known to gamekeepers as "a hawk," and its death warrant is a standing order in some preserves, though here again there has been great improvement, and the destruction of the kestrel is forbidden on many estates. The food of this bird is known to consist almost exclusively of voles, mice, and insects.

It may be observed in connection with this question of the kestrel's habits, that many people appear to be unable to distinguish between one kind of hawk and another.

It is one of the peculiarities of the *Falconidæ* that their plumage varies according to their age and sex; in the southern counties of Scotland the sparrow-hawk (PLATE V.) (which does not prey on mice) is generally known as the "blue hawk," and the kestrel as the "brown" or "red" hawk. But an immature male sparrow-hawk has reddish-brown plumage, and an adult male kestrel has a bluish-grey head and back. The Kestrel is also characterised by its

habit of poising or hovering, so that for many minutes its position in the air is practically stationary.

Buzzards and ravens destroy voles and mice, and are too heavy on the wing to do much injury to game. Rooks and crows have also been known to dig up the nests of voles and mice, and to devour the young. Amongst other birds which have been observed to prey on voles are certain species of sea-gulls.

Stoats and weasels are among the deadliest and most persevering enemies of small rodents. They kill far more than they can devour, apparently out of sheer blood-thirstiness. In woodlands and on low ground they undoubtedly do much harm to game, especially the stoat (PLATE VI.), which may be easily distinguished from the weasel (known in Scotland as the "whittret," PLATE VII.) by its greater size and by the black tuft on the end of the tail, which is retained at all seasons of the year, even in winter, when the rest of the body becomes wholly or partially white.

Adders feed readily on voles, but an adder would probably not kill more than one animal of the size of a vole in a week, so that there is no reason to extend protection to these venomous reptiles.

The natural enemies of the vole may be divided into two classes, viz., those which destroy the voles and are harmless to sheep, crops, and game; and those which, though preying on voles, are so harmful in other ways as to have less claim to preservation :—

1. *Vole-killers, harmless, or nearly so, to sheep, crops, and game:* Owls of all sorts, buzzards, kestrels, and the smaller sea-gulls.
2. *Vole-killers, hurtful in other ways:* Stoats, weasels, ravens, carrion and hooded crows, rooks, great black-backed gulls, and adders.

The Departmental Committee recommended that strict injunctions should be given by landowners that the birds mentioned in the first class should not be destroyed. Their presence in full numbers, though inadequate to avert an outbreak of voles, would undoubtedly tend to mitigate it, and, as has been proved in the case of the short-eared owl, they have the faculty of multiplying abnormally in presence of an unusual supply of food. They are, at all events, most useful allies to man in combating attacks of ground vermin.

The Committee deprecated in the strongest manner possible the use of the pole-trap for the capture of hawks. Besides the inhumanity of this device, it is indiscriminate; and harmless owls, kestrels, and buzzards are just as likely to be taken by it as are the more mischievous species.

While admitting that it was hardly reasonable to expect that stoats should be allowed to multiply in game-coverts, or in the vicinity of pheasant coops, the Committee had no hesitation in recommending that weasels, which are persistent mouse-hunters, and do little damage to game, should not be molested, at least in moorlands and hill pastures, where they can do little harm and much good.

With reference to the steps which could be taken by occupiers to protect themselves in the earlier stages of an outbreak, the Committee pointed out the importance of early information being given to the local organisations, farmers' clubs, or agricultural societies, and to all interested, of the first signs of any exceptional multiplication of voles in order that systematic and concerted attempts might at once be adopted to stamp out the plague throughout the affected district. The most effective measures of this class appear to be the periodical and timely burning of grass or heather, followed by active pursuit of the vermin by men with wooden spades and dogs. Where plantations of limited extent are attacked, pit-falls, wider at the bottom than at the top, and about 18 inches deep, have been found efficacious.

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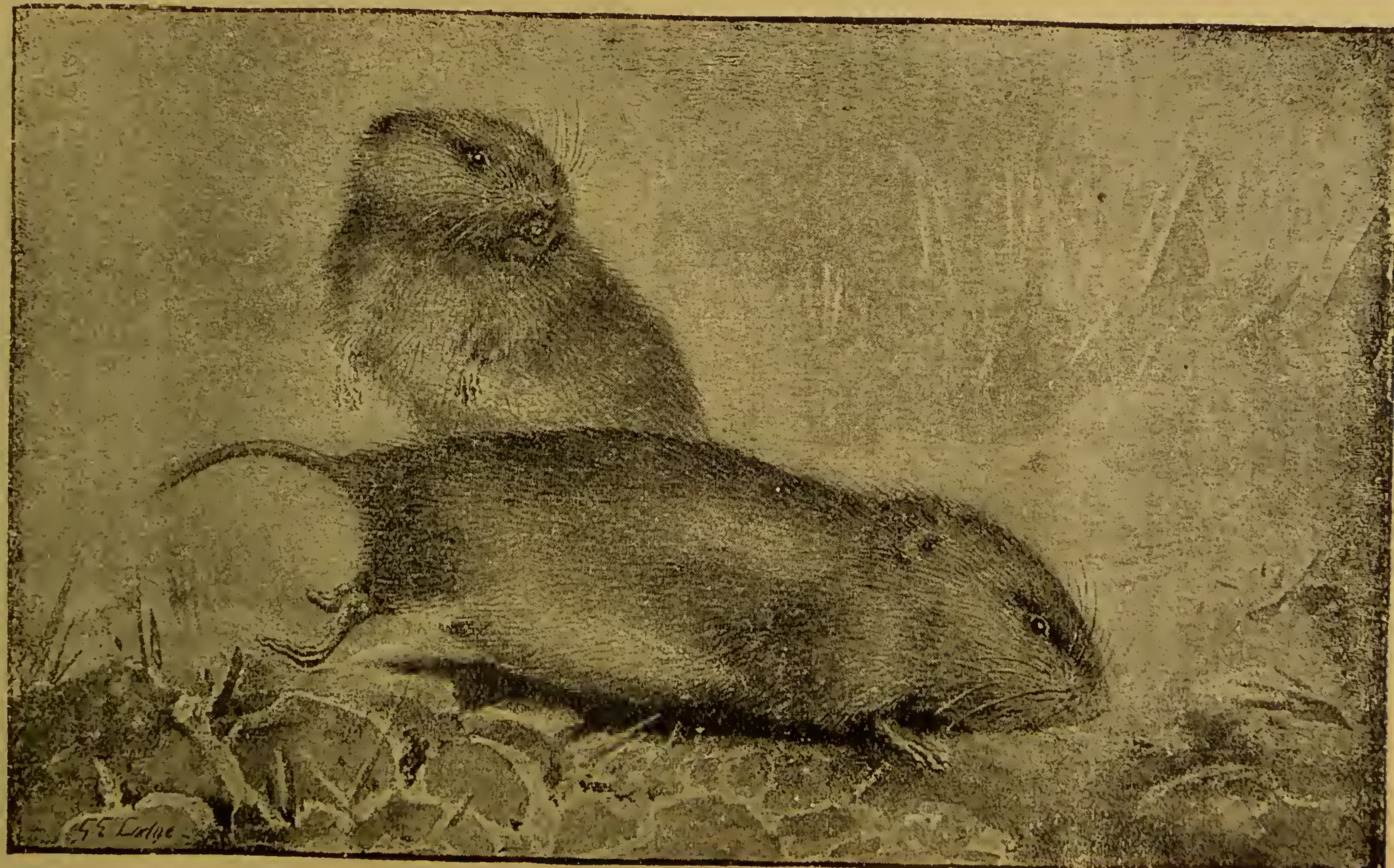
PLATE I.



SHORT-TAILED VOLE. *Microtus*, formerly *Arvicola, agrestis*.—Locally known as Field Vole, or Grass Mouse, and Meadow Mouse. Colour, reddish-brown above, paler beneath. Average length of head and body, 4 ins.; tail, 1 in. External distinguishing characters: short rounded muzzle; short ears, almost buried in the fur; short hairy tail.

PLATE II.

LONG-TAILED FIELD MOUSE. *Mus sylvaticus.*—Colour, sandy-brown above, white beneath. Average length of head and body $4\frac{1}{4}$ ins.; tail, 4 ins. External distinguishing characters: long pointed muzzle, prominent naked ears, and long naked tail.

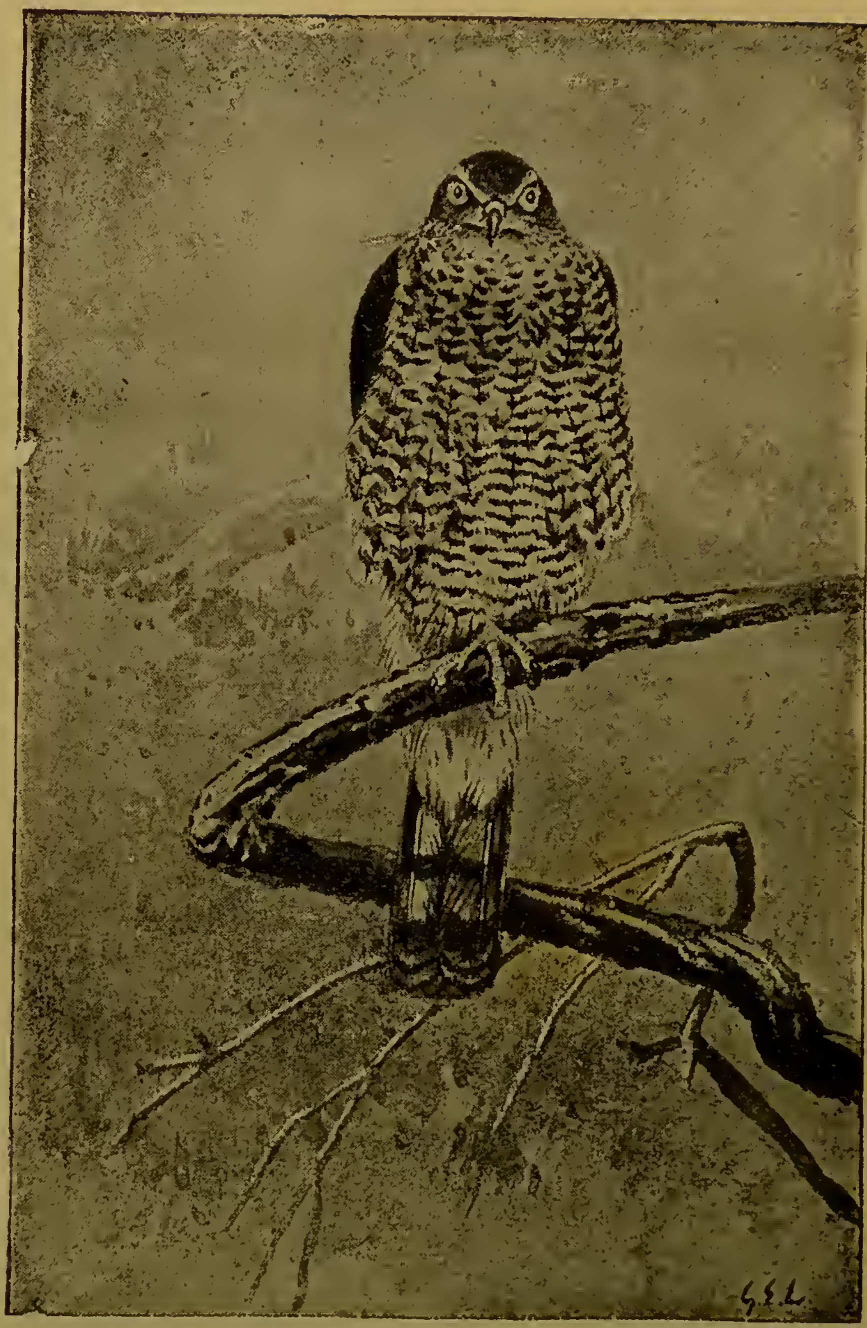
PLATE III.

SHORT-EARED OWL. *Otus brachyotus.*—Migratory, living much on the ground, and of diurnal habits. General colour, yellowish-brown above, variegated with spots, streaks, and cross-bars of a darker colour ; pale beneath. Eyes yellow. (The eyes of the White or Barn Owl and the Brown or Tawny Owl are black.) Appears usually in October (whence called Woodcock Owl) and remains until April. A few remain to breed annually in suitable situations. Preys largely on mice and voles.

PLATE IV.

KESTREL or WINDHOVER. *Falco tinnunculus.*—Locally known as the Brown or Red Hawk. A long-winged, dark-eyed Hawk, with reddish-brown back and bluish-grey head and tail when adult. Preys upon mice, voles, beetles, grasshoppers, small birds, and occasionally young game-birds. Easily recognised on the wing by its habit of hovering over the fields.

PLATE V.



SPARROWHAWK. *Accipiter nisus.*—Locally known as the "Round-wing" or "Blue Hawk."—A short-winged yellow-eyed Hawk with long-barred tail. Mottled brown above when young, brownish grey when adult. White beneath, with transverse bars on breast and flanks. Preys upon small birds, black-birds, thrushes, pigeons, and young game-birds. Does not hover like the Kestrel.

PLATE VI.

STOAT. *Putorius ermineus*, formerly *Mustela erminea.*—Locally known as Weasel, Stoat, Clubster, Lobster, and Ermine (in winter). General colour, brown above, white beneath. Tail longer than in Weasel, and with a black tip at all seasons, even in winter, when the fur becomes white or partially so. Average length of head and body, 9 to $10\frac{1}{2}$ ins.; tail, $4\frac{1}{2}$ to 6 ins. Preys on mice, voles, rats, rabbits, leverets, and young game-birds.

PLATE VII.

WEASEL. *Putorius nivalis*, formerly *Mustela vulgaris*.—Locally known as Whittret, Cane, and Mouse-hunt. Average length of head and body, 7 to $8\frac{3}{4}$ ins.; tail, 2 to $2\frac{1}{2}$ ins. Colour, reddish-brown above, white beneath; tail, brown. Does not turn white in winter. A persistent enemy to rats, mice, and voles.

BOARD OF AGRICULTURE AND FISHERIES.

Autumn Catch Crops and Fodder Supply.

The Board of Agriculture believe it may be useful to draw attention to some of the leading special and catch crops, which, in the event of an early harvest, may, under favourable conditions, prove of utility in providing green food for stock in the coming autumn, winter, and spring in districts where the recent severe and prolonged drought has seriously diminished the ordinary hay and fodder crops of the season. The policy of resorting to one or other of these catch crops must in every case be determined by the varying local circumstances of soil and climate, and cannot be made the subject of general recommendation.

Rye, if sown at once, might afford good food for stock early in the autumn, or it might be mown for hay if the land were strong and in good heart. It would furnish very early food in the spring for stock, or it could be made into ensilage. Rye in the early stages of its growth should be top-dressed freely with nitrate of soda.

Oats put in promptly would give food for soiling or cutting in the autumn. The crop might also be made into hay, and it is equally useful for converting into ensilage.

Trifolium incarnatum on suitable soils and under favourable conditions, in its three varieties, early, medium, and late, may be largely sown in proper proportions to follow in succession in cutting. It might also take the place of red and other spring-sown clovers that have failed.

Italian Rye Grass sown very thickly, and as early as possible, would under favourable conditions yield some good food in the autumn, and again in the following spring. This crop provides good fodder for dairy stock. It may be sown after vetches or grain crops from July to September, but will require a heavy manuring of nitrate of soda or other ammoniacal manure.

Trifolium pratense, or Cowgrass, if sown at once, either alone or with Italian rye-grass, might with sufficient moisture yield a good crop in the autumn. It should be simply brushed or rubbed in, or harrowed in by a chain harrow, and a roller run over it. Nitrate of soda and superphosphate may be used as manures. This clover can only be mown once, but it would afford excellent feed throughout the late summer and autumn after its crop of hay.

Refuse herbage.—Rough herbage on the outside of fields, sides of hedges, sides of roads, &c., should be mown and put into silos with any brushings of meadows and pastures.

Coarse Hop Bines may be chopped while green and put into the silo, care being taken to take out all cocoa-nut fibre strings.

Aftermath.—Pastures and meadows not wanted for stock treated speedily with nitrate of soda, would yield herbage, if not for hay, at any rate for ensilage late in the autumn.

Fern or Bracken may be made into hay, or put into the silo.

The green shoots of *Gorse* or *Whin* may be made use of for spring food in districts where these are available.

In the special circumstances of the year it may be also expedient with the view of providing sufficient supplies of fodder, to use, wherever practicable straw for the feeding of stock, and to substitute for bedding, such materials as fern or bracken, moss litter, and rushes.

4, Whitehall Place, London, S.W.,
July, 1893.

This leaflet is no longer issued.

BOARD OF AGRICULTURE AND FISHERIES.

Assessments to Local Rates.

The Board of Agriculture and Fisheries have, on more than one occasion, found it useful to circulate a memorandum, prepared by the Local Government Board, directing the attention of occupiers of land in England and Wales (outside London) to the principles upon which assessments are made to the poor rates and other local rates, and explaining the steps which may be taken, where an assessment is objected to, to obtain a reduction of the amount on the ground that their premises have been valued at too high a figure, or the valuation maintained at a level above the actual value.

It has been thought desirable to incorporate in that memorandum, in addition to the primary subjects dealt with, a reference to the bearing of the Agricultural Rates Act, 1896, whereby special and important provisions relating to the assessment of agricultural land have been enacted. The Act was originally made to operate for a period of five years commencing 1st April, 1897, but it has now been continued in force until the 31st March, 1910. The Board would also draw the attention of owners and occupiers of land to Sections IV. and V. of the memorandum, concerning the rating of woodlands and plantations, and of sporting and fishing rights.

Memorandum.

Outside London the basis for the assessment of the poor rate, and practically of every other local rate levied under the general law, is, where the Union Assessment Acts are in force, the valuation list made under those Acts. The only places in England and Wales, outside London, where the Union Assessment Acts are not in force are a few large town parishes under local Acts.

the general district rate, the lighting rate, separate rates to meet contributions required by the county council, and separate rates levied for sanitary purposes in rural districts.

When the whole parish is liable to county contributions or to the borough rate, the sum required is usually paid out of the poor rate. Where only part of the parish is liable, a separate rate is levied in such part in the same manner as the poor rate, and the same observation applies to sums required for the expenses of burial boards. All these rates are based practically on the valuation list; and it would seem that if the assessment committee amend the valuation list after hearing an objection to the list, any of these other rates should be correspondingly amended without any formal appeal against the rate.

As regards the general district rate levied by an urban authority, it was held in the case of *Sheffield Waterworks Co.* v. *Sheffield Corporation* (55 L. J. M. C. 40; 54 L. T. 179), that where, subsequently to the making and demand of a general district rate, the valuation list upon which the rate was based was amended by the assessment committee by the reduction of the assessment of particular premises, sufficient cause was shown for non-payment of so much of the rate as corresponded to the reduction in rateable value made by the committee, although there had been no appeal against the general district rate.

The urban authority are empowered to reduce the sum at which any person has been assessed in the general district rate, if he has been over-rated, *i.e.*, if he has been assessed on a higher rateable value than that entered in the valuation list in respect of his property.

If a person assessed in any of the above rates considers that he is over-rated, and is unable, in any other way, to obtain the relief to which he considers himself entitled, he may appeal against the rate.

An appeal against a general district rate lies to the next court of quarter sessions held not less than 21 days after the demand of the rate. Fourteen days' notice of the appeal must be given to the urban authority, and the notice must state the ground of appeal.

In the case of separate rates levied by overseers to meet expenses of rural district councils, the same appeal lies to special or quarter sessions, as in the case of the poor rate.

Any separate borough rate, and any separate rate to meet contributions required by a county council, may also be appealed against in like manner as a poor rate.

Appeals against rates levied under the Lighting and Watching Act, 1833, may be made to quarter sessions, and are subject to the same provisions as appeals against poor rates.

III.—*Reduced Assessments in respect of Land not occupied by Buildings.*

1. Occupiers of land used as arable, meadow, or pasture ground only, or as woodlands, allotments, orchards, market gardens, or nursery grounds, are assessable to a general district rate in an urban district in respect of such land, in the proportion of one-fourth part only of the rateable value according to the valuation list; and in the case of a separate rate for special sanitary expenses in a rural district they are, according to circumstances, either to be assessed in respect of one-fourth part only of the rateable value of the land, or are to pay in respect of it one-fourth part only of the rate in the pound payable in respect of houses and other property.

Occupiers of houses, buildings, and property (other than land) are required to pay, in respect of their assessment to a lighting rate under the Lighting and Watching Act, a sum in the pound three times greater than that paid by occupiers of land. This has been held to mean that if the rate on houses &c. is 6*d.* in the pound, occupiers of land should pay only 2*d.* in the pound.

Failure, in rating such occupiers, to allow the partial exemption for which the Acts provide, would be a good ground of appeal against any of the three rates abovementioned.

2. In the case of rates which before the Agricultural Rates Act, 1896, came into operation were payable by an occupier of agricultural land in full, or in the proportion of more than half, such occupier is liable, so long as the Act continues in force, to pay one-half only of the rate in the pound payable on buildings and other hereditaments. This partial exemption does not, however, apply to rates assessed under any commission of sewers or in respect of any drainage, wall, embankment, or other work for the benefit of the land. The expression "agricultural land" means any land used as arable, meadow, or pasture ground only, cottage gardens exceeding one-quarter of an acre, market gardens, nursery grounds, orchards, or allotments, but does not include land occupied together with a house as a park, gardens other than as aforesaid, pleasure grounds, or any land kept or preserved mainly or exclusively for purposes of sport or recreation or land used as a racecourse.

Since the 31st March, 1897, the rateable value of agricultural land is required to be stated separately from that of buildings or other hereditaments in the valuation list. The power of the assessment committee to amend the list on objection being made in the manner previously explained on page 2 is not affected by the carrying out of this requirement.

IV.—*Rating of Woods and Plantations.*

Poor Rate.—The Poor Relief Act of Elizabeth made an occupier of saleable underwoods liable to assessment to the poor rate. The underwood itself was rated, not the land upon which it grew. But by Section 14 of the Rating Act, 1874, so much of the Statute of Elizabeth as related to the taxation of an occupier of saleable underwoods was repealed, and by Section 3 of the Act, the Statute of Elizabeth, and the Acts amending the same, were extended to land used for a plantation or a wood or for the growth of saleable underwood, and not subject to any right of common.

Under this enactment it is the land, and not the timber, underwood, or other produce of the land, which is made the subject of assessment. It would seem that if land used as a plantation or a wood, or for the growth of saleable underwood, is subject to common rights, it is exempt from the poor rate and other local rates.

The method of estimating the gross estimated rental and rateable value of such woodlands is prescribed by Section 4 of the Act, and is as follows :—

(a) If the land is used only for a plantation or a wood, the value shall be estimated as if the land, instead of being a plantation or a wood, were let and occupied in its natural and unimproved state :

(b) If the land is used for the growth of saleable underwood, the value shall be estimated as if the land were let for that purpose :

(c) If the land is used both for a plantation or a wood and for the growth of saleable underwood, the value shall be estimated either as if the land were used only for a plantation or a wood, or as if the land were used only for the growth of the saleable underwood growing thereon, as the assessment committee may determine.

Land of the kind described in paragraph (a) should be assessed as if it were divested of timber or wood of any description, and its value determined without taking into account any improvement which has been made, or of which the land might be capable. In other words the land should be rated as if it were waste land. This view is supported by the case of the *Earl of Westmorland* v. *Southwark and Oundle* (1877), 36 L.T. 108 ; 41 J.P. 231, in which it was decided that in ascertaining the rateable value of a plantation

or wood as "land let and occupied in its natural and unimproved state" it was not admissible to base the estimate upon the rent which a hypothetical tenant would give after money had been laid out in grubbing up woods, in draining and fencing, and in making roads. In the case of *Eyton* v. *Mold Churchwardens and Overseers* (1880), L.R. 6 Q.B.D. 13, it was held that the value of a right of sporting over land might properly be included in estimating the rateable value of a plantation or wood as land in its natural and unimproved state.

Woodlands are not agricultural land within the meaning of the Agricultural Rates Act, 1896, and an occupier of woodlands is liable to pay the full amount in the pound of any poor rate assessed upon him in respect of such property.

Other Local Rates.—By Section 10 of the Rating Act, 1874, any hereditament made rateable to the poor rate under that Act became subject to all other local rates leviable upon property rateable to the relief of the poor. Woodlands are thus rateable to the general district rate, and the separate rate for special sanitary expenses, and to any lighting rate levied in a rural parish under the Lighting and Watching Act, 1833. Information as to the abatements allowed to occupiers of woodlands in paying the general district rate or special sanitary rate has already been given in Section III. (1).

V.—*Rights of Sporting and Fishing.*

Under the old Statute (43 Elizabeth, c. 2) the sporting right was in no case separately rated, although, where the occupier of land retained the right of sporting or let it to another person, the value of the right formed an element in estimating the value of the land to the occupier (*Reg.* v. *Battle*, L.R. 2 Q.B. 8).

Where the right is not severed from the occupation of the land (*i.e.*, where the owner retains both the land and the right, or lets them both to one tenant) the value of the sporting rights is still included in the valuation of the land; but in any other case the right must be dealt with in the manner directed by Section 6 of the Rating Act, 1874.

Sub-section (1) of that section provides that where any right of sporting is severed from the occupation of the land, and is not let, and the owner of such right receives rent for the land, the right shall not be separately valued or rated, but the gross and rateable value of the land shall be estimated as if the right were not severed. It would seem, however, that the prohibition in the sub-section of a separate valuation or rating of the right of sporting is modified by

Section 5 (*a*) of the Agricultural Rates Act, 1896, which requires that in every valuation list the value of agricultural land shall be stated separately from that of any building or other hereditament. Where, therefore, the rateable value of any agricultural land is, under the Rating Act, 1874, increased by reason of its being estimated as if the rights of sporting were not severed, the amount of such increase should, for the purpose of the valuation list, now be included in the rateable value of buildings and other hereditaments not being agricultural land.

The rate payable in respect of any sporting right so entered in the valuation list may be deducted by the occupier of the land from his rent under Section 6 (1) of the Act of 1874, unless he has specifically contracted to pay such rate in the event of an increase.

The direction in Section 6 (1) is that the value of the land shall be estimated *as if the right were not severed.* It would appear, therefore, that in dealing with the right as an element of value, it ought not to be estimated upon any such consideration as that of the rent, which a third person might be found to give for it; but according to its worth, if any, to the occupier of the land, upon the supposition that the right is not severed; or, in other words, that he himself is entitled to exercise the right without the power of making a profit by letting it.

The effect, therefore, of this provision is to place those lands which are let by an owner, with a reservation of the right of sporting, on the same footing in relation to rateability as the lands which he himself occupies, retaining the right to the game upon them.

The preceding remarks are mainly directed to those cases where the right of sporting is severed from the occupation of the land, but is retained by the owner. Where, however, the right is let to a person other than the occupier of the land, it is rateable as a separate hereditament, and either the owner or the lessee of the right may be rated, as the occupier of the right of sporting, under Section 6 (2) of the Act of 1874. The ordinary rules of law for determining the gross estimated rental and rateable value of other kinds of property will apply.

Subject to the provisions of Section 6, the owner of any right of sporting, when severed from the occupation of the land, may be rated as the occupier of the right, under Sub-section (3) of the section. But where the owner receives rent for the land he could not be rated under Sub-section (3) as the occupier of the right, because this case is dealt with by Sub-section (1) of the section.

For the purposes of the section the owner of the right is, (1) the person entitled to exercise the right if the right is not let, (2) if let, the person who is entitled to receive the rent for the same.

The poor rate, general district rate, special sanitary rate, and other local rates are payable in full upon sporting rights when severed from the occupation of the land over which they are exercised and separately assessed.

The observations relative to the right of sporting are equally applicable to the assessment of the right of fishing.

4, Whitehall Place, S.W.,
August, 1893.

Revised, August, 1905.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Ensilage.

The subject of ensilage received considerable attention at the hands of the Agricultural Department of the Privy Council in 1885, and as the result of an exhaustive local enquiry, a summary was published of Replies to Questions on Silos and Ensilage in Great Britain, in the form of a Parliamentary paper.* This was followed by a reproduction of the Reports of the private Ensilage Commission.† Ensilage was at first advocated mainly as a resource when wet weather prevented the saving of the hay crop in good condition, the contention being that it was preferable, under such circumstances, to make grass and other fodder crops into silage, and this course was widely adopted in seasons such, for example, as that of 1888. It has been subsequently claimed, however, that the utility of the system is equally, if not more, marked in a year of drought, or when the root-crop fails, as by its means green fodder may be economised and stored in a succulent state for winter keep.

When ensilage was first introduced it was generally considered that the making of silage involved the construction of a silo, *i.e.*, a receptacle of some kind with sides of brick, stone or concrete. This was often too expensive for tenant farmers, and in some cases outhouses, parts of barns, and other buildings were converted at comparatively small cost. A considerable stimulus, however, was given to the system by the discovery that good silage could be made in stacks and clamps by a comparatively cheap and simple process.

Materials suitable for Silage.

Meadow grass, lucerne, clover, sainfoin, Italian rye grass, grass and clover mixtures, maize, and any other green fodder crops that can be spared from the immediate requirements of the farm stock may be made into silage. In America by far the most important silage crop is maize, and of late years increased attention has been given to its cultivation in this country. It is sown from the middle of May to the middle of June, care being taken to obtain seed of high germinating power. The only serious trouble after sowing arises from the attack of rooks, and the workers engaged in sowing should not leave the field until they have set up some means of effective protection.

If the object in view is to provide for the deficiencies of a season of drought, the crop should be allowed to stand as late as the weather will permit, for although under ordinary circumstances it is acknowledged to be best to cut such crops

* C.—4536.

† H. C. 308 of 1885 and H. C. 119 of 1886.

as grass and clover for silage when in flower, this must be sacrificed with the view of getting the greatest possible bulk of material at such a time.

Every particle of herbage upon farms may, if necessary, be utilised for silage, even weeds and nettles having been successfully employed. The margins of fields and the sides of hedges and other waste places may be brushed and the material so obtained ensiled. The leaves and young shoots of most hardwood trees may also be ensiled. If the material is too coarse for actual silage it will be useful for topping up the silos, stacks, or clamps. Coarse grass in meadows, pastures, and under trees in orchards and elsewhere, which stock frequently reject, may be made into eatable silage. Hop bines may be ensiled directly the hops have been picked, before the sap has disappeared.

Preparation of Materials.

Grass, clovers, lucerne, vetches, &c., require no preparation. They are simply mown as closely as possible and carted to the silo, stack, or clamp, and put in, or on, and compressed as tightly as possible that the air may not penetrate between the layers. Where hop-bines are utilised, and a silo is available, it is well to cut them with the implement used to prepare them for manure, or they may be put into stacks or clamps whole, or cut into long lengths. Maize is usually roughly chaffed when put into silos, though it may also be employed uncut.

Special machines may be obtained for chaffing silage materials, and elevators for stacking them.

Silos.

Silos will naturally be used when available, and buildings that can be readily and economically converted may be made with some advantage into temporary silos. Silos, as compared with stacks and clamps, entail less waste, and are easier to manage.

To get sweet silage the silo should be filled somewhat slowly to obtain a temperature of from 130° to 160°, which neutralises the acid fermentation. If the temperature falls much below this, sour silage is produced.

When the silos are filled the contents are pressed down by levers or machinery, or the necessary consolidation is secured by weighting with any kind of convenient material, such as earth, sand, bricks, or stones, piled upon planks and boards.

Silage Stacks.

Silage stacks are made in the same way as ordinary hay stacks. The materials are carted and stacked either in circular, square, or oblong stacks. It is important to have great and regular pressure, which may be adjusted, or which

adjusts itself, as the mass shrinks. If this is obtainable, the materials may be put together as quickly as may be convenient. Several methods of pressing, as by chain pressure, hydraulic presses, and lever appliances, have been patented. Before pressing, the material should be carefully levelled.

Silage stacks may also be made without special machinery. In this case the material cannot be put together so quickly, and every part must be most carefully and firmly trodden, especially that near the outsides. Poles may be pitched at the corners and sides of the stack, and braced together at the top to guide the stack makers. A framework of four large planks may be made round the poles, and drawn up as the stack progresses by pulleys fastened to each end of the bracing at the top. This will keep the stack in shape, and allow the outsides to be well trodden down. The boards may be used to cover the stack when made, and heavily loaded with bricks, stones, or other weighty substances. The whole should be covered with straw or other material to keep out the wet.

A well-known pioneer of the ensilage movement has given up silos and makes silage now entirely in round stacks. They are built slowly and not pressed or weighted until complete. A layer of rough grasses or weeds is put at the bottom, and similar material is used to top up. The surface is trodden down, and sand or earth is laid on the top to a depth of about six inches. A trench is dug round the stack if the surface drainage is not good, the earth from this serving to cover the silage. " No mode of compression has been found " so good," he writes, " as earth or sand, it follows the " ensilage down much better than any other mode of " weighting. A little attention is necessary for a day or two. " to see that it goes down without cracking. In building " the stack it should be kept full in the middle, in order " that it may finish convex." He also recommends the use of a mixture consisting of a layer of one load of oats, peas, beans, vetches, and Italian rye grass, alternating with a layer of meadow grass. Materials for making a silage-stack should be used whole as a rule, and carted at once after cutting.

Dry earth may be spread either directly on the silage or on intervening sheets of corrugated iron, felt, &c. In this case no other covering will be required.

Silage Clamps.

These are simple and inexpensive receptacles of the green crops enumerated above. They are advocated by practical men as most valuable, especially in times of emergency, and some stock-owners who have silos prefer to adopt clamps.

They may be made on slightly sloping ground by stumping out the required size, the length exceeding the breadth, and carting material for silage within this area. The carts must be drawn on and over the heap precisely as when a manure mixen is made, and tipped where material is required to fill

up. They must be drawn as closely to the sides as possible so as to give pressure there. When the middle has risen too high for further carting the sloping ends and sides are cut off and the material thrown on to the clamp, and levelled, and firmly trodden in. Then dry earth should be laid evenly upon the clamp, to a depth of 8-10 inches, either with or without an intervening layer of rough herbage, bracken, or leaves.

On dry soils a trench may be dug 3 ft. deep, and of length and width according to the quantity of material. This may be packed tightly into the trench by the carts being led over it. A heavy roller drawn over the mass will help to consolidate it. The soil from the trench can be used for covering and weighting the clamp. Practical men say that the material cannot be too juicy and even wet to make good silage by this process.

Old chalk pits, so numerous in some districts, form serviceable receptacles for silage. The carts should be led over the mass, which must be finally left in a somewhat conical form, and covered with earth to a depth of from 10 to 12 inches.

Where earth is used as a covering for silage stacks or clamps occasional inspection is necessary, as the earth sinks with the silage, and cracks are sometimes formed which must be filled up.

The use and value of Silage.

Many stock-owners make silage regularly, and use it as a valuable addition to ordinary food for stock. In one instance an owner of 45 dairy cows for some years kept his cows almost entirely upon silage made in stacks, with an allowance of oil cake. There is much other testimony as to its value for feeding milch cows as well as breeding ewes. For fatting beasts it has been claimed that well-made silage is as valuable as a combination of hay and turnips, and for lean stock of all kinds it may be used as a substitute for either hay or roots. Farm horses will do well on properly made silage.

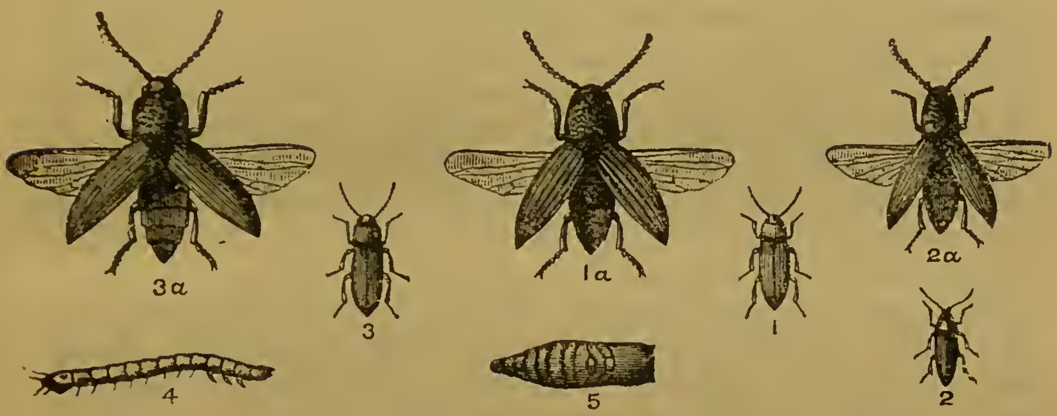
It can be given by itself, either cut or whole, or it may be chaffed with straw or hay. In seasons when hay and straw are scarce, and there is little of either to spare for cutting into chaff, silage may be given alone, when it proves of great value for supplying the bulky food that is absolutely essential for the health of ruminants.

4, Whitehall Place, London, S.W., August, 1893.
Revised, January, 1902.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Wireworms.



1 and 1*a*. *Agriotes lineatus.* (Natural size and magnified.)
2 and 2*a*. *Agriotes sputator.*
3 and 3*a*. *Agriotes obscurus.*
4. Larva of *Agriotes lineatus.* (Natural size.)
5. Pupa.

Description and Life-History.

Wireworms are the larvæ of beetles known popularly as Click Beetles or Skip Jacks; they belong to the large family of *Elateridæ*. The chief culprit of these, without any doubt, is the Striped Click Beetle (*Agriotes lineatus*). The beetle is called " click " beetle, because when held by one end it bends its body and produces a clicking sound; while the name Skip Jack is derived from the fact that, when placed on its back, it throws itself into the air, also making a peculiar click in so doing.

Hardly any crop is free from wireworm ravages. Corn, roots, and vegetables of all kinds suffer in turn; hop and strawberry plants and tomatoes often receive serious injuries from these insects. When wireworms have got into the fibrous roots of these plants it is difficult to get at them, and they bite the shoots as fast as they make their appearance, and eat the softer parts of the roots. In newly planted hop grounds, wireworms are often most destructive, destroying every shoot, checking growth, and sometimes killing the stock outright.

Wireworms are more to be dreaded than most other insects, because they are general feeders, not confining their attacks to the plants of a single natural order, and because they feed upon stems and roots at all times and seasons of the year, except during very hard frosts, when they go deeper into the earth; as they live for at least three years in the wireworm stage, their work of mischief is of long duration.

The most common species of these beetles, *Agriotes lineatus* (Figs. 1 and 1*a*), is three-eighths of an inch long, and its wing expanse is slightly over half an inch. Its thorax is tawny; the wing cases are brown, with lines of yellowish brown. The antennæ are reddish yellow, and the legs brown. Two other species are shown in the figure.

These beetles are found under stones, at the roots of grasses, upon grasses and various flowers and trees, in hedges and fields, and upon reeds. They fly well, and lay eggs near the roots of grasses, corn plants, and weeds, or in the earth. Taschenberg says that the beetles live all the winter in places of shelter and concealment, and that pairing takes place during the first warm days of spring. The wireworms which hatch from the eggs live in the earth, near the roots of the plants on which they feed.

The larva (wireworm) of *Agriotes lineatus* (Fig. 4) is from six- to seven-eighths of an inch long, very shiny, and of yellow colour, becoming more chestnut coloured when dead. It has a few hairs on its body, one pair of four-jointed legs on each of the first three segments, and a swelling on the lower surface of the terminal segment. It has very strong jaws well adapted for biting roots. With these jaws it quickly tears away the soft parts of the slightly bulbous stems of wheat, oat, and barley plants just above the roots, and kills the plants; it also bites the sprouting bines in hop-hills, and the slender roots of young turnips, mangolds, carrots, cabbage, lettuce, &c.

After from three to five years, according to circumstances, the larva goes down deep into the earth, makes a little oval cocoon of particles of soil, and changes to a pupa (Fig. 5), from which the beetle emerges in two or three weeks.

Prevention and Remedies.

Numerous experiments both in the field and in the laboratory have been made to find out some way by means of which wireworms may be killed in the ground. Hitherto all experiments have failed except those with bisulphide of carbon, which is too expensive to use over large areas as in field cultivation.

There are nevertheless certain measures which will materially lessen the damage from these ground pests.

(1.) Much good may be done in hop yards, gardens, and nurseries by trapping the click beetles. This may be done by laying about on the ground small heaps of lucerne, clover, or sainfoin, and covering them over with tiles or pieces of board during May and June and as long as the beetles are noticeable. They fly to these heaps and shelter beneath the green material, particularly if the ground is clean, and deposit their eggs there. These traps must be examined as often as possible, the beetles should be collected and the green stuff destroyed every ten days, and the ground beneath well

beaten down so as to destroy any eggs that might be present. Boards or tiles might be placed beneath the bait so as to prevent any eggs from getting on the soil. As many as 100 click beetles have been taken from a single trap in a week.

(2.) Clover ley and grass land are always full of the larvæ of these beetles, and the result is that when the land is broken up the first few crops are generally a complete failure, unless proper steps are taken to free the land from wireworm. Land previous to being ploughed deep should be fed off by sheep, the sheep being penned and fed so that not only all surface vegetation goes, but the land becomes well trodden down and saturated with urine, &c. Gas-lime spread over the surface some time before ploughing would probably be beneficial.

(3.) For young crops, such as wheat, where wireworms are at work, heavy rolling with a ring roller does much good by consolidating the soil, and so preventing the wireworms from moving rapidly from plant to plant.

(4.) Mustard and rape cake dust has been much employed as a wireworm remedy. It is thought that these substances get rid of the pests ; on the contrary, they form a palatable food for Elater larvæ. They act by drawing the wireworms away from the plants, and in young crops good is no doubt for a time done by allowing the plants to grow away from the pest. The cake dust has no lasting effect and moreover probably encourages wireworm in the land. There is no doubt that the use of such manures as rape dust in hop gardens has tended to the great increase of these pests there.

(5.) Neither gas-lime, lime, nor salt, so often recommended, has any definite effect upon the larvæ in the ground, but the first-named now and then seems to act as a deterrent and may be used with advantage on infested land prior to its being broken up. Gas-lime must be left for at least four weeks before it is worked into the land. The quantity depends entirely upon local conditions, soil, &c.

(6.) Stimulating manures should always be given when the crop is seen to be attacked by wireworms. Soot has been found to answer well and under certain conditions seems to have even a definite effect upon the insects.

In districts where sea-weed is used as a manure, it is said wireworms do very little harm.

(7.) Trapping the larvæ is also often successful. This is done by placing pieces of potatoes, or, best of all, beet root under the earth in hop-hills, garden borders and so forth, marking the spots with pegs, and examining them every few days. Numbers of wireworms may be found buried in the baits and may then be collected and destroyed.

(8.) In flower beds and borders where these pests do much harm to tender plants they can easily be destroyed by injecting bisulphide of carbon into the soil. This may be done as follows :—Pour a quarter of an ounce of bisulphide of carbon into a small hole made in the ground, and at

once cover over with a piece of tile with earth on the top. Care must be taken not to let the bisulphide touch the roots of any plants, and it must be remembered that this substance is both poisonous and highly inflammable. This operation is best done in the spring and early summer, the quantity of bisulphide of carbon indicated being enough for a square yard.

(9.) Heaps of leaf mould and manure should never be allowed to have weeds growing on them, and are best covered with a coating of gas lime, which prevents not only click beetles, but also daddy longlegs from laying their eggs there. Gardens are frequently infested in this way, unless proper precautions are taken.

(10.) Rooks, starlings, jackdaws and plovers destroy large numbers of wireworms. The plover does the greatest amount of good in this respect, and the recent great increase in the wireworm is undoubtedly partly due to the decrease of the green plover, owing to the ruthless destruction of eggs.

(11.) Clean farming and suitable manuring are amongst the best preventives.

In the Journal of the Board of Agriculture and Fisheries for March, 1904, a correspondence is quoted to the effect that hide salt applied to the land in the autumn, before ploughing, proves an efficient remedy for wireworm. The result may not prove entirely satisfactory from the first application, and in such cases a repetition of the dressing should be made annually until the pest is got rid of. The dressing should not exceed 3 cwt. per statute acre. Experiments are being conducted to test the treatment thoroughly.

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BOARD OF AGRICULTURE AND FISHERIES.

The Daddy Longlegs or Crane Fly.

(*Tipula oleracea, Tipula paludosa, &c.*)

1.

2.

3.

Summer Crane Fly (*Tipula oleracea*). 1. Female (after Ormerod). 2. Larva. 3. Pupa.

The larvæ, or grubs, of the huge, awkward, long-legged flies known familiarly as "Daddy Longlegs," are frequently very destructive to various crops of the farm and garden. These grubs are called "leather jackets" in some counties on account of the toughness of their skins. They attack indiscriminately all kinds of corn, grass, turnips, mangolds, clover, peas, beans, cabbages, and garden plants. Perhaps in the aggregate they do most damage to grass land, but the results of their attack are most conspicuous on cereals, and especially on oats after clover or ley. It is in spring or early summer that complaint is most often heard, and many cases of serious damage were recorded in 1904.

Description and Life History.

The term "Crane Fly" is applied indiscriminately to the two common species known to naturalists as *Tipula oleracea* and *Tipula paludosa*. The habits of both are identical, but *Tipula oleracea* is the earlier insect of the two and occurs from May to August, while *Tipula paludosa* is met with from July (rarely June), to September, in which month, and also in August, the perfect insects may be found

in great numbers issuing from the pupal cases in pastures, or engaged in laying their eggs. *Tipula oleracea* may be recognised by the presence of a pale longitudinal streak below and parallel to the front margin of the wing; in *Tipula paludosa* the wings are darker brown and without a pale streak in the female, and only a trace of it in the male. The body of the male, which is always smaller than the female, is in both species slightly swollen at the tip and ends abruptly, while in the female it terminates in a short pointed ovipositor. In colour *Tipula paludosa* is reddish

4. Summer Crane Fly (*Tipula oleracea*). Male; natural size.

brown, while *Tipula oleracea* is a greyer insect; in the female of the latter the wings are large and longer than the body, but in the female of *Tipula paludosa* they are much smaller and are conspicuously shorter than the body. The females of both species are rather less than an inch (11 lines), in length, with a wing expanse of two inches in *Tipula oleracea* as against an inch and a half in the case of the female of *Tipula paludosa*. The legs, as indicated by one of the popular names, are very long and slender, the hindmost pair being the longest.

There are several other species which are also injurious, including the Yellow Spotted Crane Fly (*Pachyrhina maculosa*).

The *larva* or grub is about an inch long. It is somewhat variable in colour, but generally brownish, or brown shaded with dark green, or sometimes lighter and approaching ash-grey. Two light-coloured lines may be traced down the back.

It puts out at pleasure its black head, furnished with strong jaws for biting; and on the hind surface of the last segment are the two openings which lead into the breathing tubes. At the tail end, which is cut square, there are several tubercles. Though it has no legs it moves about with comparative ease.

The *pupa* is nearly as long as the larva, and is brown in colour. In changing, spines are formed at each segment, as shown in the figure, by means of which the pupa wriggles up through the earth and the fly escapes, leaving the chrysalis case sticking half out of the ground. It is easily recognisable by the two curved horn-like processes in front.

It has been observed that while laying eggs the female moves over the ground with her body in a vertical position, by the help of the hind-legs—the two pairs of forelegs being in the air—and of the end of the abdomen, which performs the office of another pair. The eggs are placed by the ovipositor on the ground, or upon grass, weeds or rubbish. Egg-laying takes place in late summer and autumn. According to Curtis one female will lay as many as 300 eggs. The eggs are elliptical in shape, and in colour are shining black: it is believed that they are hatched in about 15 days. The larvæ lie in the earth during the winter, feeding upon the stems of grasses and corn near the surface while the weather is open, and going deeper into the earth when frost comes. They have been found well grown and feeding voraciously on the roots and stems of corn and grasses in the month of January when the weather has been mild. There is room for accurate observations on the length of the life-cycle of the different species and the number of generations in a year.

Prevention and Remedies.

(1) Congenial habitats of the Daddy Longlegs flies are wet ditches, damp sides of hedgerows and headlands, marshes, and low-lying and undrained meadows. These are generally their headquarters and breeding places, and obvious methods of checking their increase are to keep ditches well brushed and cleaned out, to keep hedgerows well trimmed, and to drain wet land.

(2.) Grass and clover fields may be ploughed in July, care being taken to have the herbage well covered. This system is not uncommon in certain districts, where it is known as bastard fallowing.

If it is not practicable to break up the grass or clover leys so early, they may be dressed in July with three or four tons per acre of gas lime, which will destroy eggs or larvæ.

If neither of these suggestions is feasible, leys that are intended to be broken up in autumn should be kept as closely grazed as possible.

(3.) There is evidence that the larva of one species completes its feeding somewhat sooner than is generally

believed. If this be so it would justify a later sowing of the oat crop when "grub" was feared. There are disadvantages attending such a late sowing, and some would prefer to take the risk of "grub" rather than run the danger of the crop failing, owing to weather conditions, from a late sowing. Late sowing has been practised with success on some farms in Aberdeenshire.

(4.) If no method of prevention has been attempted, or if the result is not satisfactory, something in the nature of a cure may be attempted in spring, provided the attack is not very virulent and is taken in time.

Towards the end of April, or early in May, when spring-sown oats are 2 to 3 inches long, they should be dressed with 1 to 2 cwt. per acre of nitrate of soda, or with 1 cwt. of this manure mixed with 2 to 3 cwt. of soot. After the dressing the land should get a double-harrowing, and a thorough rolling with a heavy Cambridge roller. The harrowing brings a considerable number of the grubs to the surface, where they are preyed on by rooks, starlings, and other birds, whilst the roller kills a considerable proportion.

Top-dressing with kainit at the rate of 3 to 4 cwt. per acre has been tried with some success.

If towards the end of May it is considered that the crop is practically a failure it should be ploughed up, and about the end of June white turnips, rape, or mustard may be sown. By that time the "Leather Jackets" are getting into a quiescent condition, and are not likely to damage the new crop, and if the weather is favourable the crops indicated will keep down weeds and yield useful green food for autumn feeding.

(5.) When drilled crops, such as turnips, mangels, and potatoes, are attacked, the best plan is to diligently hoe by horse and hand. In this way many of the grubs are destroyed, or are exposed to the attack of birds.

(6.) Rooks, starlings, peewits, and other birds, devour the grubs in a wholesale manner. Starlings are especially useful when they congregate after the breeding season. It has been noticed that meadows and marshes near rookeries have escaped injury, while grass-lands at some distance from these sustained much harm.

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BOARD OF AGRICULTURE AND FISHERIES.

The Gooseberry Saw-fly. (*Nematus ribesii.*)

FIG. 1.

Figures 1 and 2. Larva in the two last stages.
3. The Cocoon. 4. The Fly.

The Gooseberry Saw-fly is very troublesome in gooseberry plantations and gardens, and it also attacks red currant bushes, but not so frequently as gooseberry bushes. In many cases the leaves are quite cleared off, together with the young fruit, and unless the plague is checked it is sure to be renewed in succeeding seasons. When it has once established itself in large plantations it can only be eradicated by wholesale methods. This insect is common in many European countries, and appeared in America and Canada about thirty-five years ago. It has now spread over the greater part of the American continent, according to Professor Saunders, who believes that it was brought into America in the earth adhering to the roots of imported gooseberry and currant bushes.

Life History.

The fly (Fig. 4) appears in April or May, according to the nature of the season. The female is rather more than a third of an inch in length, with a wing expanse of over half an inch. The body of the female is of the

colour of honey; the wings are iridescent; the head and thorax are dark coloured; and the legs are yellowish with black feet. The male is smaller than the female; its body is much narrower and darker in colour.

The females lay a great number of greenish-white eggs, which are placed close to the ribs on the under side of the leaves, now and then along the edges of the leaf, and fastened there with an adhesive substance. Larvæ come from the eggs in about six days. They are originally only about the twelfth of an inch long, but when full grown they are nearly an inch in length, with disproportionately large heads, and twenty legs and sucker-feet. The larvæ are at first almost white, with a few black spots at the fore part, and a black head. At the first change of skin the colour becomes green, the spots become very numerous, and the legs are ringed with black. After the last moult they have no spots and are very light green, except the first and last segments, which are yellow. After feeding for about four weeks, the larvæ spin oval cocoons (Fig. 3) of a brown colour, generally upon, or just beneath, the surface of the earth under the infested bushes. Occasionally the cocoons from the first broods of larvæ are found upon the stems and twigs of the bushes. It has been noticed that the cocoons of the summer broods are yellowish or yellowish brown. These cocoons are usually covered with particles of soil on the outside. The saw-flies come from the summer cocoons in about twenty days. The cocoons of the last broods are found deeper in the ground than those of the summer broods, and the saw-flies do not come from these until the spring. There are three generations during the year. The last generation of larvæ enter the earth, but do not change to pupæ for some weeks or even months. Unfertilised females sometimes lay eggs, which always produce male saw-flies.

Remedies.

The eggs are laid on the under side of the leaves, and, being conspicuous, they may be easily collected in plantations that are known to be subject to attack. Directly the larvæ hatch they commence eating the leaves, and their presence is at once detected by the numerous small holes. Leaves are with a little experience easily seen and picked off either with the eggs on them or *before the larvæ crawl away*. Thousands of eggs or young larvæ may be thus destroyed, and where circumstances permit it, children can be employed to pick the leaves.

Hellebore wash is used with great advantage in this country and in the United States and Canada. This insecticide is poisonous, and is dangerous if it is used within six weeks of the fruit being gathered.

Hellebore should be mixed with water in the proportion of one ounce to 3 gallons of water and 2 ounces of flour, and applied with proper spraying machines, either "Knapsack" or hand sprayers fitted with proper nozzles. It must be kept constantly stirred.

Paris Green, syringed over the bushes at the rate of half an ounce of Paris Green to ten gallons of water, is extensively adopted against this insect. A small quantity of lime must always be added to the wash. London Purple has been used with benefit, put on in a fine spray at the rate of one pound to 200 gallons of water. Neither of these poisons must be used for six weeks before the fruit is gathered, green or ripe.

Strong lime water has been found serviceable. This should be put on in a fine spray directed over every part of the bush for some time. Dry dressings of hellebore, soot, soot and lime, &c. have been used with more or less success, but are not nearly as certain in action as washes.

The ground under and close around infested bushes may be dressed with quick-lime in the autumn, and dug deeply. Gas lime is also valuable for this purpose. To prevent the flies from coming up from the cocoons, gardeners sometimes stamp or beat down the earth in the early spring close round bushes that have been infested. By far the best remedy for this Saw-fly in gardens is to remove the surface soil for a depth of two inches under the bushes in winter and bury the earth deeply in some hole dug for the purpose; fresh earth or manure may be put in its place.

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BOARD OF AGRICULTURE AND FISHERIES.

Acorn Poisoning.

The Board of Agriculture and Fisheries consider it desirable to warn stockowners who are accustomed to turn cattle into parks, or on to commons, or other places where acorns are plentiful, that there is considerable risk of injurious effects arising from the consumption of large quantities of acorns, which, in cases of dearth of herbage, are certain to be eaten with avidity.

In the years 1868, 1870, 1884, and 1900, which were remarkable for a large yield of acorns after a long, dry, and hot summer, serious losses among young cattle occurred from outbreaks of what is known as the acorn disease, or acorn poisoning. In many districts, notably in Middlesex, Kent, Hertfordshire, Warwickshire, Lincolnshire, Northamptonshire, Wiltshire, Gloucestershire, Devonshire, the New Forest, Sussex, Surrey, Suffolk, Norfolk, and Derbyshire, extensive outbreaks of the disease occurred. Young cattle up to two years old suffered most severely. Milch cows and cattle over three years old were seldom affected. Sheep and pigs appeared to be unsusceptible to the poisonous action of the seeds, and only two or three cases of the disease were reported in these animals, while entire herds of young cattle were attacked and a large proportion of them succumbed.

Acorn poisoning is quite distinct from indigestion due to eating an excessive quantity of acorns. This accidental disorder may occur in ordinary seasons when animals are first allowed access to pasture where acorns abound. But the true acorn disease is distinguished by progressive wasting, entire loss of appetite, diarrhœa, discharge of an excessive quantity of pale urine, sore places inside the mouth, discharge from the nostrils, and also from the eyes, which are always sunken, giving to the animal a peculiar haggard expression. No fever is present from first to last, but, on the contrary, the temperature is commonly below the normal standard.

On post-mortem examination it is frequently noticed that all traces of the acorns have disappeared. The morbid changes are such as are seen when an irritant poison has been given.

Remedies of various kinds were tried in the great outbreaks of the disease, but no cure was discovered. Prevention is comparatively easy when the risk is realised.

It is only necessary for absolute security to keep cattle from the pastures while acorns are falling. The danger will be materially lessened by collecting the acorns from the pastures, but this device does not prevent a considerable consumption of the nuts which fall during the night. If swine are allowed access to pastures on which acorns fall they will devour large numbers, on which they will thrive well, and, at the same time, proportionately reduce the quantity within the reach of cattle. It has also been suggested that when cattle are allowed access to acorns only during the daytime they should be supplied with a liberal allowance of food before they are turned out.

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BOARD OF AGRICULTURE AND FISHERIES.

The Raspberry Moth (*Lampronia rubiella*, Bjerk).

Moth and caterpillar, both magnified ; the lines show the natural size.

The small red caterpillars of this moth, often called the Raspberry Stem-bud Caterpillar, are most destructive to raspberry canes. On many fruit farms the crop has been reduced by one-third or one-half in consequence of the attack of this insect, and much mischief is also often occasioned by it in gardens and allotments where patches of raspberry canes are cultivated. Upon close examination of the attacked raspberry canes it will be seen that the soft juicy part at the base of the buds has been eaten away, so as to injure the buds and prevent their foliage and sometimes the blossoms from being put forth. The larvæ also feed on the pith inside the terminal shoots; the attacked shoots flag and then die away in very characteristic manner. A hole in the cane at the base of the buds may often be noticed in which the pupa will be found ensconced, and sometimes the pupa may be found in the tunnel of the shoot.

Description of the Moth.

The *Lampronia rubiella*, or Raspberry Moth, belongs to the group *Tineina*. It is a most beautiful moth, of a light brown colour, with a series of yellow dots and spots upon its forewings, the two most prominent being on the inner margin. The hinder wings are slightly lighter in colour, with light fringes. The head is yellowish-grey, and the antennae dull brown. It is barely half an inch across its wings, and its body is only about the fourth of an inch in length. It may be seen in the end of May, but is most common in June, flying round the raspberry canes.

Life History.

The moth places its eggs upon the flowers of the raspberry canes from the end of May to the middle of June. After five or six days the caterpillar may be found in the raised white receptacle upon which the fruit (or more correctly, the collection of little fruits composing the raspberry) is formed. The caterpillar does not appear to injure the fruit, nor, indeed, to feed at all at this time. In time the caterpillar makes its way out of the receptacle, either by crawling or by letting itself down by silken cords to the earth beneath the canes, and passes the winter in a flat white silken cocoon about $\frac{1}{12}$ of an inch in diameter. These cocoons may also be found in crevices in the poles and under the rough rind of the stems. It emerges from this state of hibernation on the first approach of spring*; according to Dr. Chapman it leaves the cocoon early or late in March, according to the season. It crawls up the raspberry canes, and, getting to the bud, worms itself into these at their base, and, feeding upon them, makes up for its long fast during the autumn and winter months.

When the time arrives for pupation, the caterpillar scoops out a hole in the pith of the canes, below the base of a bud, in which it turns to a chrysalis; the moth coming out in about 21 days.

The larva is close upon a quarter of an inch long, decidedly pink in colour for the most part, though the shade varies somewhat in individuals, and becomes more red in most larvæ as they get older. The head is black, and there is a patch of black divided in two on the first segment. It has three pairs of black feet on the thoracic segments. The pro-legs number four pairs, and there is a pair of anal feet.

The pupa is about the fourth of an inch long, tapering somewhat unusually, and has a curious spine upon the back on the last segment; it is reddish-yellow in colour, the wing covers paler, the abdomen somewhat pink.

Methods of Prevention and Remedies.

The caterpillars hibernate just under the surface of the ground, around and among the stocks of the raspberry canes, and in crevices in the poles, &c., and, as has been shown, they remain there from about midsummer until March. Therefore, deeply forking the ground round and between the stocks with a pronged fork, or even hoeing it with a three-toothed hoe, would destroy some and bury others so deeply that they could not get out. Cutting back the canes after an

* In 1892 caterpillars of the *Lampronia rubiella* were first found in raspberry buds on April 10th.

attack, and, as far as possible, doing away with stakes will have a good effect.

Dr. Chapman has suggested the following practical method of prevention : "The caterpillars are in the crown of the stock, or near it, and under rubbish there collected. Rake this away, and earth the stock up again, and you will thus bury them, and most will perish."

Soot, lime, ashes, or soot and lime mixed, which form a pungent compound, might be forked or hoed into the ground in the autumn or winter.

When raspberry canes in field culture are nearly all cut away, so that there are but few canes or stems left, it would be easy to put a little thick soft soap composition containing paraffin oil, or some other offensive stuff, with a large paint brush, at the beginning of March, upon the lower part of each cane that is left, in order to prevent the caterpillars from crawling up, and it would also damage those that may hibernate there.

Cutting off and burning the infested canes while the caterpillars are in the buds between April and the beginning of June, would destroy many caterpillars and pupæ. This may be very freely done, as raspberry canes throw up plenty of shoots to take the place of those cut away, and infested canes bear little or no fruit.

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BOARD OF AGRICULTURE AND FISHERIES.

The Apple Blossom Weevil (*Anthonomus pomorum*).

a, Weevil, nat. size; *b*, magnified. *c*, Larva, nat. size; *d*, magnified. *e*, Pupa, nat. size; *f*, magnified. *g*, Larva in blossom bud.

This insect very frequently causes much harm to the apple crops, and in the last few years its injuries have much increased in fruit-producing districts. Close examination of the blossoms shows that the little creamy-white larvæ of the weevil are in the centres of the flowers (Fig. *g*), destroying their powers of fructification. The action of this weevil upon the fruit blossoms of apple and sometimes pear trees is often mistaken for the effects of white frosts, when the petals have become brown or rust-coloured; but if such blossoms are closely inspected, either the very pale yellow pupa of the weevil (Fig. *e*) will be found in them, or a little round hole in the side of the withered flower will be noticed, showing that the perfect weevil has eaten its way out of its cradle. Attacked blossoms readily fall when a tree is shaken, and very often naturally before the weevils escape. The beetle may remain some days in the dead blossom before it makes its exit.

Incredible damage is often caused by this weevil in apple and pear orchards in France. In some Departments, syndicates of defence against it have been formed, consisting of a committee in each Commune, to carry out a series of

operations calculated to destroy this dangerous enemy, as it is felt that it is only by united action among cultivators that such injurious insects can be stamped out.

Description.

The apple-blossom weevil is very small, only the fourth of an inch long, and the eighth of an inch in breadth (Figs. *a*, *b*). It is black, with down, or pubescence, of an ashy grey hue upon its body. Occasionally, specimens are found almost pitchy in colour. The thorax is black with coarse scanty white pubescence. The wing-cases have alternate bare and pubescent grey lines ; behind the middle is a band composed of pale pubescence which is oblique, and forms, when the two wing-cases are closed, a characteristic pale V-shaped mark. There is a pale grey spot between the wing-cases in front. The legs are very dark reddish, almost black; the thighs of the first, or anterior, pair are large, and each is furnished with a formidable tooth. The middle and hind femora have a smaller tooth ; the feet, or tarsi, are of a darker colour. The rostrum, or snout, is the most remarkable feature, being half as long as the body, slightly curved, and bearing the antennæ, which end in oval four-jointed club.

Like many other weevils, the apple blossom weevil falls down when disturbed, tucks in its legs and snout, and remains motionless, feigning death until the danger has passed.

The egg is yellowish and oval.

The larva, or grub, is without feet, and is about the third of an inch long (Figs. *c*, *d*). It is wrinkled, and white at first, gradually becoming creamy-white. It has a brown head with two little brown spots on the first segment.

The pupa is nearly a quarter of an inch long, of a very pale yellow colour, with a long beak, or rostrum, and the legs folded on the under side of its body (Figs. *e*, *f*).

Life History.

In the first warm days of spring, the weevils issue from their winter retreats, and find their way to the apple trees. Some authorities consider that the females seldom use their wings, and that only the males fly freely. Others hold that both sexes fly equally well.

The female, either by flying or crawling, finds her way to the blossom-buds of apple and sometimes pear trees, and boring a hole with her snout, puts one egg within each blossom bud, and carefully closes up the hole. A female lays from 15 to 50 eggs, but puts one only in each flower-bud. The process of laying one egg takes about three-quarters of an hour.

Oviposition in an individual female may extend over a fortnight at least. The eggs hatch in from five to nine days. The larva, which lies in the bud in a curved form, attacks the stamens and carpels, and soon causes the petals to wither; the flower-bud changes to a rusty hue and decays (forming the so called "capped" buds). The larva in from 8 to 20 days turns into a pupa, the pupal state lasting from 7 to 10 days, when the weevil appears and escapes by a hole which it bores through the petals.

After this, the weevils live among the leaves of the fruit trees. It is not known whether they feed upon the leaves. A French authority, Dr. Henneguy, concludes from careful observation that they do not feed at all, but live upon a reserve of fat, stored up in their bodies during their previous state. They are not seen after the end of September, retiring for hibernation to chinks in the bark of apple and other trees, or concealing themselves beneath lichenous and mossy growths upon their branches, as well as under stones and rubbish beneath and around the trees, and in other similar refuges.

According to natural instinct, the weevils do not appear until the weather is mild and the flower-buds have begun to swell. If the season is, and continues, warm and growing, the effects of the attack are usually of a slight character. But should the weather be cold and changeable, as is so often the case in Great Britain and the north and western parts of France, the flower-buds are slowly developed, and the weevils lay their full complement of eggs, the hatching of which takes place before the flowers are fully open. They do not appear ever to lay their eggs in an open flower.

Varieties of apple trees which blossom very early and very late are more likely to escape the attacks of the weevil than those of the main crop whose blossom comes late in May in ordinary seasons.

Methods of Prevention, and Remedies.

1.—One mode of prevention is to spray the limbs and branches of apple trees, in February, with caustic alkali wash to destroy the lichens and mosses which serve as harbours for this weevil and other insects (*vide* Leaflet No. 70). This can be thrown up over the trees by means of a syringing machine with a powerful pump.

2.—All long grass, leaves, and rubbish should be cleared away underneath fruit trees on grass land.

3.—It is difficult to employ insecticides and insectifuges advantageously for this insect, but it might be useful to spray trees subject to its attack with kerosene emulsion made by dissolving ½ lb. of soft-soap in one gallon of boiling water, and pouring this while still boiling hot into

two gallons of paraffin, and churning violently till a butter-like mass results. For use dilute with thirty to forty parts of water. The emulsion should be sprayed over the trees in a fine mist. This might tend to prevent the weevils from egg-laying.

4.—A mode of decreasing the number of weevils consists in shaking the branches to make the insects fall on to cloths spread below. Cloths—old rick-cloths being best—may be cut and arranged so as to fit close round the trunks of the trees. Labourers can then shake the branches violently, with the aid of long poles with hooks at the ends. The cloths should be quickly swept with brooms, and the débris and the weevils shovelled into sacks. This must be done rapidly, before the weevils can get away. It is said that four men and two boys treated 110 trees in a day in this manner. If this is done, a still day should be chosen if possible.

From experiments made, it has been found necessary to perform this operation two or three times on each tree, as all the weevils cannot be shaken off at once. From a tree, for instance, from which at the first shaking 1,000 weevils had fallen, 385 were shaken off five hours later. In one orchard of 8 acres, having 347 trees, nearly 450,000 weevils were destroyed in three days, at a cost of 1*l*. A satisfactory crop of apples was obtained.

It should be pointed out that this operation must be carried out before the weevils have laid their eggs, and upon their first appearance, commencing with the earliest varieties of apple trees.

This mode of destroying the apple-blossom weevils might be advantageously practised in Great Britain. It need hardly be pointed out that the fruit growers in districts should combine to wage war in this fashion simultaneously, and with care and energy.

5.—Theobald recommends shaking down the attacked blossoms, which should be collected immediately, as should also any blossom that has fallen of itself, and burnt, for the destruction of the enclosed weevils.

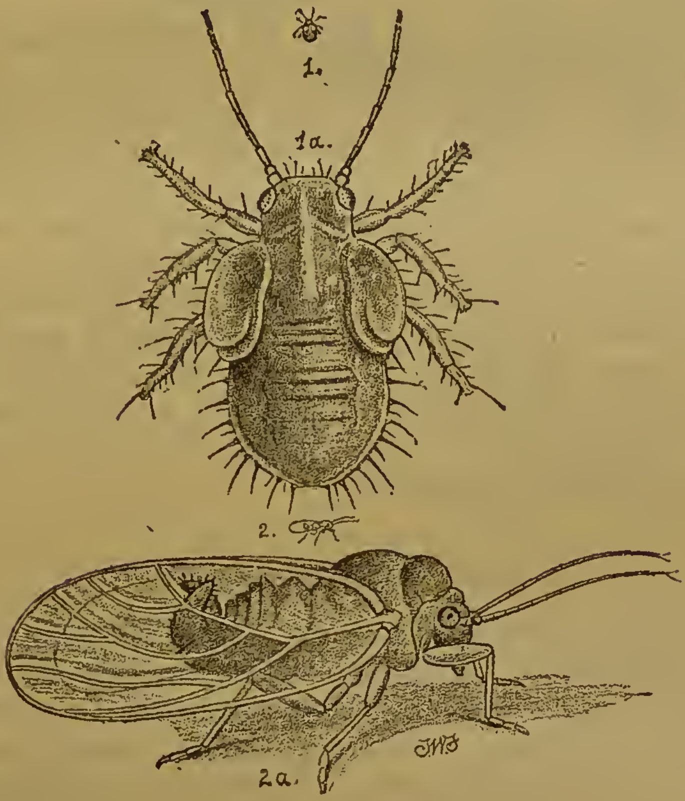
4, Whitehall Place, London, S.W.,
October, 1893.
Revised, September, 1905.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 16.

BOARD OF AGRICULTURE AND FISHERIES.

The Apple Sucker (*Psylla mali*, Förster).



1, larva, nat. size. 1*a*, larva after third moult, much magnified. 2, perfect insect, nat. size. 2*a*, much magnified.

This insect is frequently the unsuspected cause of much injury to the apple crop. Its larvæ, which cause the mischief, are so small and so closely concealed in the buds, that they may be easily passed over by casual observers. Their action upon the flower and leaf buds is often confounded with that of their relation, the aphides, which appear at about the same time. Later in the spring they suck away the juices from the stalks of both blossoms and blossom-buds. These *Psylla* larvæ may be seen by careful inspection within the folds of the buds. Attached parts punctured by the beak of the pest are drained of their sap; they fail to develop, wither and fall off.

Although the *Psylla mali* has been known in Great Britain for a long while, it is only somewhat recently that it has been recognised as a serious trouble to apple growers. It is well known in many European countries. In Germany it has done considerable harm, and the well-known economic

entomologists, Schmidberger and Taschenberg, have written able treatises upon it. An allied species known as *Psylla pyricola* is very destructive in pear orchards in America, and has been elaborately described by Professor Slingerland, of the Cornell University Agricultural Experiment Station at Ithaca, in the State of New York.

Parts Attacked.

The leaf-buds, which may be destroyed.

The foliage leaves, which may be wrinkled, and become pale in colour and look frosted.

Flower-buds. Attack is worst on these, so that the collections of flower-buds do not expand and fruit fails.

From June onwards the adults may be seen on the leaves, but, in comparison with the earlier stages of the insect, they do little harm; but they are the egg-producers.

In addition to symptoms of attack mentioned above the presence of the pest can also be recognised by small opaque globules in and about the unopened flower-buds. After a while, too, the buds become filled with a dirty sticky fluid termed "honey-dew" which issues from the larvæ and mingles with their excretions.

Description of Insect.

Many persons have, there is no doubt, noticed quantities of little yellowish, or greenish-yellow, fly-like insects upon the leaves of apple trees in September and October, which upon being approached give a leap before using their wings to carry them to another leaf. These, in a certain degree, resemble some of the "frog-hoppers" and, in fact, they have been mistaken for them, but close examination will show them to be very different.

The winged *Psylla*, the perfect insect, appears from the middle of May to the middle of June and later. Its colour is green, with slight tinges or shades of yellow. The colour, however, is rather variable, differing according to the sex, and time of year. At some periods there are shades of yellow, green, red, or brownish-red, noticeable upon the body. These are more pronounced at pairing time, and the female is more brightly coloured than the male. The wings are transparent, or slightly testaceous; the legs and antennæ are yellow, the latter having two and sometimes four dark-coloured joints at the ends. The male is about one-twelfth of an inch, in length; the female is slightly larger.

The eggs are white or slightly yellow, and somewhat spindle-shaped; a thread-like appendage occurs at the pointed end. Taschenberg says that they become red, or yellowish-red, in the spring, just before the larvæ emerge from them.

The larvæ on hatching are very small, and have flat dirty yellow bodies, with brown or dark spots upon them. Their eyes are red and their feet brown. The changes in colour and form that accompany development will be noted under the life history.

Life History.

Pairing takes place in September, and the egg-laying may continue to November. In autumn of the abnormal year 1893 females were seen laying eggs as late as the 3rd of November. As a rule, the eggs are laid singly, and imbedded in the fine hairs upon the epidermis of the shoots. Occasionally there are two or three together in a row. The eggs are generally laid upon the youngest shoots. They are also placed upon older shoots and upon branches, but are then difficult to discover on account of the deep furrows and cracks, and mossy and lichenous growths.

The eggs remain until the weather becomes spring-like, when tiny flat larvæ emerge from them and at once get into the nearest buds. In the course of development of the larvæ several moults take place. The first moult soon occurs, after which the larva protrudes a small white globule, which remains attached by a white thread to its body. Should this be removed, another speedily forms. After a few days, when the second moult is accomplished, the larva becomes light green, and numerous white threads are produced forming a tangled mass, with which the larva covers itself. After about another week, with the third moult, the rudimentary wings are developed, as seen in Fig. 1*a*, and the eyes and tips of the antennæ become dark. This is the nymph stage. From the first appearance of the larva and until it is about a month old, there are continuous changes in its form. At the end of this time the nymph moults and the winged *Psylla* appears. The perfect *Psylla* appearing in May and June is said not to pair till September. Taschenberg inclines to the belief that there may be another generation during the summer, and it certainly is strange that the insect should pass so many weeks in apparent inactivity. Schmidberger, however, does not hint at a second generation, and no such brood has been observed in Great Britain.

Prevention and Remedies.

The times when measures may be taken with best results against the Apple Sucker are in the early spring and autumn.

1.—In the case of the early sorts of apples, infested trees should be sprayed with Paraffin Emulsion directly the apples

have been picked, to prevent the *Psylla* from laying eggs upon the shoots, and to kill the adults. The formula for Paraffin Emulsion is :—

Paraffin	... ...	2 gallons,
Water ...	... ...	1 gallon,
Soft Soap	... ...	$\frac{1}{2}$ lb.

Boil together the soft soap and water, and while still boiling hot pour into the paraffin ; churn thoroughly by means of a force pump till a creamy butter-like mass results. The thorough churning is important, as, if properly made, the stock keeps for a long time. For use, dilute with 10 gallons of water.

2.—Carbolic acid might be used at the rate of from 2 to 3 gallons to 100 gallons of water, and 6 lbs. of soft soap.

3.—For a winter spray the caustic alkali fluid described in Leaflet No. 70 is recommended, but proof is still wanting that this destroys the eggs.

4.—Spraying when the buds are open, and the larvæ are exposed, would be efficacious if carefully performed. The wash would run down into the bases of the open flower buds and of the expanded leaf-buds, and make the quarters of the insects unpleasant, or destroy some of them. The paraffin and the carbolic washes would kill the larvæ with which they come in contact. If the paraffin emulsion spray be used at this time the stock when made must be diluted with 30 times the amount of water. Spraying should be done as early as possible in the course of the attack, before much "honey-dew," which would hinder the action of the washes, has been exuded.

5.—Some small amount of prevention would ensue from pruning trees on which eggs had been laid. On young small trees, bushes, and pyramids, this might be adopted, and it would probably be advantageous to prune them, if infested, more closely than usual. But in the case of large orchard trees, it would be impossible to rely upon this mode of prevention. It is most important that all prunings should be burnt.

4, Whitehall Place, London, S.W.
December, 1893.

Revised, September, 1905.

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BOARD OF AGRICULTURE AND FISHERIES.

Preservation of Commons.

The Board of Agriculture call attention to the recent Act of Parliament amending the law relating to Commons with a view to their better preservation and in connection with previous enactments.

By the Law of Commons Amendment Act, 1893, lately passed, it is enacted that an inclosure or approvement of any part of a Common purporting to be made under the Statute of Merton and the Statute of Westminster the second, or either of such statutes, shall not be valid unless it is made with the consent of the Board of Agriculture, who in giving or withholding their consent are to have regard to the same considerations, and are if necessary to hold the same inquiries, as are directed by the Commons Act, 1876, to be taken into consideration and held by the Board before forming an opinion whether an application under the Inclosure Acts shall be acceded to or not.

By the 6th section of the Copyhold Act, 1887, the lords of manors were forbidden to make grants of land not previously of copyhold tenure to any person to hold by copy of court roll or by any tenure of a customary nature without the previous consent of the Land Commissioners (now the Board of Agriculture), who in giving or withholding their consent were to have regard to the same considerations as are to be taken into account by them on giving or withholding their consent to any inclosure of common lands.

By the 31st section of the Commons Act, 1876, it is provided that any person intending to inclose or approve a Common, or part of a Common, otherwise than under the provisions of the Act, shall give notice to all persons claiming any legal right in such Common or part of a Common by publishing at least three months beforehand a statement of his intention to make such inclosure, for three successive times, and in two or more of the principal local newspapers in the county, town, or district in which the Common or part of a Common proposed to be inclosed is situate.

It follows from the above enactments that an inclosure of part of a Common, whether purporting to be made under the Statutes of Merton and Westminster the second, or

either of them, by way of approvement on the ground of sufficient pasture being left for the commoners, or under copyhold grant founded on a custom of the manor, cannot now be legally made without the consent of the Board of Agriculture, who in giving or withholding their consent are to have regard as well to the benefit of the neighbourhood as to private interests; and that any person intending to make such an inclosure should publish notice of his intention in the local newspapers.

4, Whitehall Place, London, S.W.,
December, 1893.

This leaflet is no longer issued.

BOARD OF AGRICULTURE AND FISHERIES.

Fertilisers and Feeding Stuffs Regulations, 1897.*

The Board of Agriculture, in pursuance of the provisions of the Fertilisers and Feeding Stuffs Act, 1893, do hereby make the following Regulations as to samples to be taken under the said Act.

Commencement.

1. These Regulations are to take effect on the first day of July, one thousand eight hundred and ninety-seven, and to remain in force until altered or revoked by the Board of Agriculture.

Definitions.

2. In these Regulations :—

"Authorised representative" means any person authorised by the District Analyst to take samples, with the approval of the body who appointed the District Analyst.

"Buyer" and "seller" includes their respective agents.

"Fertiliser" means any article sold for use as a fertiliser of the soil, which has been subjected to any artificial process in the United Kingdom or imported from abroad.

"Feeding stuff" means any article sold for use as food for cattle, which has been artificially prepared.

Other terms have the same meaning and scope as in the above-mentioned Act.

Appointment of Agent.

3. An appointment of an agent by the buyer may be in the Form A. set forth in the Schedule hereto or in a form to the

* No. 419 of 1897.

like effect; and the provisions of these Regulations relating to a buyer shall apply to an agent appointed by the buyer for the purposes of the above-mentioned Act.

Proceedings by Buyer to procure Samples.

4. When the buyer of not less than half a hundredweight of a fertiliser, or of any quantity of a feeding stuff, desires to have the same analysed in pursuance of the fifth section of the above Act, he is, within ten days after delivery of the article to him or receipt of the invoice, whichever is later, either to give notice to the seller that he intends to take samples of the article himself, or to give notice in writing to the District Analyst or authorised representative, stating that he desires that the samples shall be taken by the District Analyst or authorised representative, as the case may be.

Regulations as to Samples taken by Buyer.

5. When the buyer intends to take the samples himself, he is to give at least three days' notice in writing of such intention to the seller, with particulars as to the place, day, and hour, of sampling. If the seller does not attend, the samples are to be taken in the presence of a witness, who is to initial each sample.

6. The buyer is forthwith to deliver or send by post to the District Analyst, one of such samples, with the invoice or a copy thereof, and also, in the case of a feeding stuff, any circular or advertisement of the seller descriptive of the article to be analysed, which the buyer may wish the District Analyst to consider in making his analysis and giving his certificate.

7. One of the remaining samples is to be delivered or sent by post to the seller, and the other is to be retained by the buyer.

Regulations as to Samples taken by District Analyst or Authorised Representative.

8. When the buyer or the seller desires that the samples shall be taken by the District Analyst or authorised representative, he is to give notice in writing to that effect to the District Analyst or authorised representative, as the case may be. Such notice is to contain the names and addresses of the buyer and the seller, and such particulars as may be necessary to enable the District Analyst or authorised representative to identify the article to be analysed, and may be in the Form B. set forth in the Schedule hereto or in a form to the like effect. A copy of any such notice given by the seller is to be sent at the same time to the buyer.

9. The District Analyst or authorised representative, as the case may be, is to give at least three days' notice in writing to the seller and to the buyer, as to the place, day, and hour, of sampling, to enable them to be present at such sampling, if they so desire.

10. One of the samples taken by the District Analyst or authorised representative is to be retained for the use of the District Analyst in making this analysis, another delivered or sent to the seller, and the third delivered or sent to the buyer.

11. Any notice or sample required by these Regulations to be given or sent by the District Analyst or authorised representative to the buyer or the seller, may be sent by post to the respective names and addresses stated in the notice to be given under Article 8.

12. The District Analyst, or authorised representative, as the case may be, is, at or before the time of sampling, to be supplied by the buyer with the invoice or a copy thereof, and also in the case of a feeding stuff, with any circular or advertisement of the seller descriptive of the article to be analysed, which the buyer may wish the District Analyst to consider in making his analysis and giving his certificate.

13. The District Analyst or authorised representative is to provide any receptacle or other thing required by him for the samples.

General Regulations for taking Samples.

(*a.*) *Fertilisers.*

14. When the fertiliser is delivered in bags or other packages, a number of bags or packages are to be selected as follows, viz. :—

Not less than 2 bags or packages where the quantity does not exceed 1 ton,

Not less than 3 bags or packages where the quantity does not exceed 2 tons,

Not less than 4 bags or packages where the quantity does not exceed 3 tons,

and one additional bag or package for every additional ton or part of a ton ; provided that in no case need more than 10 bags or packages be selected.

15. The selected bags or packages are to be emptied separately on a clean and dry stone or wooden floor, worked up with a spade, and one spadeful from each set aside. The separate spadefuls are then to be thoroughly mixed

and any lumps broken up by the hand or spade. From this mixture three samples, each from ½ lb. to 1 lb. in weight, are to be taken and carefully and securely packed.

16. When the fertiliser is delivered in bulk, then, in like manner, portions are to be taken from different parts of the fertiliser, and thoroughly mixed together, and the samples taken from a portion of such mixture.

17. When the fertiliser consists of bulky material, uneven in character and likely to get matted together, such as shoddy, wool, refuse, hair, &c., portions are to be taken from the selected bags or packages, or from different parts of the fertiliser, if in bulk, the matted portions torn up, and the whole mixed as above directed, but no sample is to be less than 1 lb. in weight.

18. As an alternative method, where neither the seller nor the buyer signifies objection thereto, samples of a fertiliser delivered in bags or other packages may be taken by a sampling pale or spear or pipe or tube, which shall not be less than twenty-four inches in length, and two inches in diameter. The total quantity so abstracted for the samples shall be not less than five pounds where the quantity of the fertiliser does not exceed five tons, and not less than ten pounds where the quantity exceeds five tons, and shall be drawn from at least double the number of bags or packages required to be selected under Regulation 14.

(*b*.) *Feeding Stuffs.*

19. When the feeding stuff is in the state of meal or grain, it is to be sampled in the same manner as prescribed for fertilisers. When the feeding stuff is in the state of cake, a number of cakes are to be selected as follows :—

Not less than 3 cakes where the quantity does not exceed 1 ton.

Not less than 5 cakes where the quantity does not exceed 5 tons.

Not less than 10 cakes where the quantity exceeds 5 tons.

20. The selected cakes are to be broken into small pieces such as could be passed through a half-inch sieve. These pieces are to be thoroughly mixed, and from the mixture three samples, each not less than 1 lb. in weight, are to be taken.

21. In the case of a feeding stuff, if any appreciable portion be mouldy, sour, or otherwise unsuitable for feeding purposes, or if cakes be full of hard lumps, or have cotton or

hair attaching to them, separate samples are to be taken of such portion or cakes and of the residue of the feeding stuff. An estimate is to be formed as to the proportion of the feeding stuff represented by each sample.

22. When the feeding stuff is in a fluid or semi-fluid condition, three packages are to be selected, and a portion taken from each. The several portions are then to be well mixed together in a clean vessel, and three samples taken therefrom as in other cases.

General Directions.

23. In every case the sampling is to be done as quickly as is possible consistently with due care, and the material is not to be allowed to be exposed any longer than is absolutely necessary.

24. The object of the person taking the samples is to obtain samples fairly representing the bulk from which they are drawn, and therefore no bag, package, or cake is to be selected which has apparently been damaged while in the possession of the buyer.

25. Each sample is to be packed in a dry clean bottle, or jar, or (except in the case of a fertiliser) in a dry clean tin, or in some other suitable manner, so that the original composition of the fertiliser or feeding stuff may be preserved.

26. The samples are to be so packed and secured that they cannot be tampered with, and are to be sealed and initialed by the person taking the sample. They may also be sealed by the buyer and the seller, if present and so desiring. Each sample is to be marked with the name of the article, the date and the place of the sampling, and with some distinguishing number.

Regulation as to Samples sealed by Seller and Buyer.

27. Where any samples are taken in the presence of, and sealed by, the seller as well as the buyer, such samples are to be deemed, as between the buyer and seller, to have been taken in accordance with these Regulations.

Revocation.

28. All Regulations heretofore made by the Board of Agriculture in pursuance of the provisions of the Fertilisers and Feeding Stuffs Act, 1893, are hereby revoked as from the time at which these Regulations take effect.

Short Title.

29. These Regulations may be cited as the Fertilisers and Feeding Stuffs Regulations, 1897.

In witness whereof the Board of Agriculture have hereunto set their Official Seal this first day of June, one thousand eight hundred and ninety-seven.

(L.S.) T. H. ELLIOTT,
Secretary.

4, Whitehall Place, London, S.W.,
December, 1893.

Re-issued, March, 1904.

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SCHEDULE.

Form A.

Appointment by Buyer of Agent for purposes of the Fertilisers and Feeding Stuffs Act, 1893.

I, *A.B.*, of hereby appoint *C.D.*, of *or* the Secretary for the time being of the Association [*or as the case may be*] to do on my behalf all things necessary for the purpose of obtaining an analysis under the Fertilisers and Feeding Stuffs Act, 1893, of the fertiliser *or* feeding stuff bought by me under an invoice, a copy of which is annexed.

Form B.

Request that the Samples may be taken by District Agricultural Analyst.

To,

[*Here insert name and address of the District Agricultural Analyst.*]

I, *A.B.*, of hereby request that the necessary samples for the purposes of the Fertilisers and Feeding Stuffs Act, 1893, of the under-mentioned fertiliser *or* feeding stuff may be taken by you or by some person duly authorised by you, for which I enclose the prescribed fee of shillings.

Name and Address of Buyer.	*Name and Address of Seller.*	*Description of Fertiliser or Feeding Stuff identifying the Parcel.*	*Place where the Fertiliser or Feeding Stuff can be sampled.*

N.B.—A buyer giving this Notice should send therewith the invoice or a copy thereof, and also, in the case of a feeding stuff, any circular or advertisement of the seller descriptive of the article to be analysed, which the buyer may wish the Analyst to consider in making his analysis and giving his certificate.

A seller giving this Notice is at the same time to send a copy thereof to the buyer.

BOARD OF AGRICULTURE AND FISHERIES.

The Pea and Bean Weevils (*Sitones lineatus*, and *S. crinitus*).

The Striped Pea and Bean Weevil (*Sitones lineatus*). 1. Natural size. 2. Magnified.

Plants Attacked.

Peas and beans are very subject to attacks by the Pea and Bean Weevils, but the injury is frequently attributed to sparrows and slugs, because the weevils are not by any means easily seen, and readily fall to the ground when alarmed. The weevils eat the leaves and young shoots of the pea and bean plants, and the larvæ devour their roots. They are often most troublesome in market gardens and allotment grounds as well as in the fields, and in some years an extensive reduction in the crops of peas and beans has resulted from their attacks. They have also been known to attack sweet peas in gardens. *Sitones* seriously injure red clover in its early stages, and their small white maggots, or larvæ, also spoil "second cuts" of clover by eating the roots of the plants and stopping their growth. Trifolium, too, suffers considerably, particularly in its early stages, from the attacks of these weevils, although the injury is generally attributed to slugs and other insects. Reports of damage to lucerne have also been received, and one species attacks tares.

Description of the Beetles.

The commonest species is the Striped Pea Weevil (*S. lineatus*.) This is from one-fourth to one-fifth of an inch in length. Its ground colour is dark, but the body

is covered with greyish scales, which in some specimens are of a slightly greenish-grey shade. There are three lines of this grey, or grey-green, hue on the thorax, and many lines, lighter and darker alternately, on the wing cases. Some specimens are of a uniform colour. The antennæ are of a dull red colour, very slender, with club-like terminations. The legs are ferruginous, and the male has the anterior tibiæ curved and armed with a small hook. On the under surface the beetles are clay-coloured or dull grey, so that when they fall on their backs to the earth they can scarcely be detected.

Although not so abundant as the Striped Pea Weevil, the Spotted Pea Weevil (*S. crinitus*) also does much harm. It is smaller than *S. lineatus*, more of a grey or reddish colour, fresh specimens having almost a coppery sheen and with more or less distinct dark patches on the elytra. The bases of the legs are dark, the other portions dull red. Like the former it may be found almost uniform in colour, sometimes ochraceous grey, and may easily be known by its spotted elytra and by its often chalky appearance. It is somewhat local, and is particularly prevalent in the London district and on the South Coast. *S. crinitus* is very partial to tares.

Another species, *S. hispidulus*, is also common on clover in sandy districts, in some localities taking the place of *S. lineatus*. This weevil is black, covered with fuscous-brown scales, the thorax with three paler lines, the elytra with small black patches and stiff grey bristles; the eyes are flat, not prominent as in *S. crinitus*. In the South of England another species (*S. humeralis*) also occurs in numbers on trefoils. It resembles the previous weevil, but instead of erect bristles on the wing cases has a pale patch on each side of them. It has apparently a similar life-history to the Striped Pea Weevil.

Life-History.

The beetles lay their eggs either upon or just beneath the soil close to the roots of their food plants. The eggs hatch into small, white, footless, wrinkled grubs, with brown heads and biting jaws. These grubs feed on the roots of peas, beans, clover, sainfoin, and lucerne. When full-grown the larvæ are about one-fourth of an inch in length and pupate in an earthen cell. The pupæ lie in this cell—which is not lined with silk—at a depth of about two inches below the surface of the ground. At first the pupa is pale creamy-white; later the eyes become black and the proboscis-sheath darkens. The adult beetles hibernate in great numbers in barley ricks, and even, it is said, in barley stubble, but chiefly in hedgerows and other places. These hibernators

appear early in spring, attack the young peas and beans as soon as they appear above ground, and lay eggs on or near the roots. From these eggs larvæ appear, which from the end of May to the middle of June reach maturity and give rise to a summer brood of the beetles. A large number of these lay eggs which hatch into larvæ in the autumn; these live on the roots of clover, lucerne, &c., and feed there all the winter, doing considerable harm. The winter larvæ mature in May and appear as adult beetles in June. In some cases they have been known to come from the pupal condition as early as March. Thus the *Sitones lineatus* may live in one of two ways during the winter, either by hibernating in the adult form, or by feeding, in the larval stage, on the roots of clover, &c. The larvæ bore channels along the main roots of the plant and also seem to feed on the nodular growths found in the roots of leguminous plants.

The beetles are very active on the wing early in the year, especially on warm days, but they may also be found on damp foggy days well into autumn. In spring time they have frequently been noticed in numbers with the Bean Beetles (*Bruchus rufimanus*), on the blossoms of the gorse, and also on broom. The beetles eat out notches in the leaves of the young peas and beans and so interfere with the growth of the plant; in severe infestation the leaves may be eaten to the midribs. Warm dry weather and a rough tilth, especially the latter, favour these pests. When the weather is cold, the beetles shelter beneath clods, &c., and in dry weather even enter cracks in the ground. The habit of feigning death, so common amongst the weevils, is well shown in these species. As soon as the observer approaches them they fall to the ground on their backs, and lie as if dead until the danger appears to be past.

Methods of Prevention and Remedies.

(1.)—*Garden Cultivation.*—Lime, soot, or lime and soot mixed may be advantageously distributed over infested plants while the dew is upon them, or after rain. Finely-powdered guano may also be used in this way. An observer has found that, by covering the rows with fine earth, his peas have been kept free from this pest.

Spraying the rows of peas with arsenical washes has been found beneficial. Applications of weak mixtures of paraffin and water, with a little soft soap, would make infested plants distasteful to these insects.

Liquid solutions and finely powdered materials can be easily applied and well distributed with knapsack-machines.

When peas and beans are attacked, it would be desirable to press the soil tightly and firmly close round the plants, in order to prevent the beetles from coming up from the earth.

This might be done when the plants are young by men and boys walking with a foot on either side of each row.

(2.)—*Field Cultivation.*—An attack of these weevils may be materially lessened by running a light wooden roller over the peas when the ground is dry, so as to break down many of the rough clods, beneath which the beetles shelter in inclement weather. This should be followed by a good dressing of soot and lime broad-casted over the field.

Great numbers of beetles have often been noticed in carts used for carting barley, and amongst the refuse when barley is being threshed and during harvesting operations generally. Wherever possible the beetles should be collected, or swept together, and destroyed.

Summer-fallowing of land after an attack would be very desirable. Wheat after clover-ley is often infested by swarms of these weevils. In this case it would be dangerous to sow any leguminous crop. If it is sown the land should be "broad-shared," or cultivated and ploughed. The stubble should be burnt. The burning of stubble, weeds, roots, and rubbish is but seldom practised in these days, and it is believed that the infrequency of this practice is one cause of the more numerous and more destructive visitations of insects injurious to crops.

Infested clover leys should be deeply ploughed, with a "skim" coulter on the plough, and thoroughly well pressed. Roots on the top should be removed and burnt, not carted to the outsides and left in heaps.

4, Whitehall Place, London, S.W..
May, 1895.

Revised, May, 1905.

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BOARD OF AGRICULTURE AND FISHERIES.

The Magpie Moth (*Abraxas grossulariata*).

1, Moth ; 2, Caterpillar ; 3, Cocoon. All natural size.

The caterpillars of this moth, called the "Magpie Moth" from its peculiar markings, often cause serious injury to the gooseberry and currant crops. They are sometimes also destructive to apricot trees, and are frequently found upon the plum, sloe, bramble, and hazel. The attacks of these caterpillars upon gooseberry and currant bushes are often confounded with those of the larvæ of the Gooseberry- and Currant-Sawfly, *Nematus ribesii*, but they are essentially distinct. The insects differ materially in every stage. In the winged state there are no points of resemblance, and in the larval conditions the *Abraxas* caterpillars are different in size, colour, and shape, from the grubs of the sawfly. Their habits also are distinct, for the caterpillars of the Magpie Moth live through the winter in the larval state, and are ready to attack the fruit bushes directly there is a vestige of green upon them, whereas the sawfly grubs are hatched from eggs laid by the female flies upon the leaves in the spring, and do not, therefore, appear until vegetation is well advanced.

It is fortunate that the Magpie Moth is not nearly so abundant as the sawfly, but when it gets a footing in fruit plantations and gardens it is most important that active steps

should at once be taken to arrest its progress. In 1876, 1881, 1885, it was unusually prevalent, and in the season of 1895 many complaints were received of harm caused by it to gooseberry and black currant bushes.

Description.

The Moth *Abraxas grossulariata*, which belongs to the *Geometridæ*, is a very pretty insect, nearly one inch and three-quarters across the wings, and over an inch long in the body. It varies greatly in colouring, but the typical moth has a yellowish body with a black spot on the thorax and a row of six black spots along its back. The fore wings have a white ground, with many black spots dotted irregularly upon them, with yellow blotches at their bases and an orange coloured band beyond the middle. In some specimens the black spots on the fore wings are almost confluent, while in others they are few and far between. The hinder wings are white with black spots round the margins, and other black spots placed irregularly upon them. The head is black, with short antennæ.

The egg is yellow and somewhat broad, with rows of dots upon it.

The caterpillar, when adult, resembles somewhat curiously the parent moth in its distinctive markings and coloration. It has a black head, and its body is whitish-yellow with a row of variously shaped large black spots along its back, and a row of much smaller black spots on the upper part of each of its sides. There is also a continuous band of a dark orange colour running from head to tail on each side, and below this another row of black spots, and two narrow black stripes underneath the body. The first two and last two segments are somewhat coloured with orange. There are three pairs of claw feet, which are black, and only two pairs of sucker feet, so that it progresses by a series of loops. It is an inch and a quarter in length when fully extended.

The pupa is black and has three rings of a golden colour at the extremity. It is sometimes fastened to the leaves or stems by means of threads, or the caterpillar lets itself down to the ground and pupates there under leaves, weeds or clods and on walls.

Life History.

The Magpie Moth appears late in the summer, and places eggs upon gooseberry and currant leaves, near the midribs, in groups of three or four, or singly. In about 11 days the caterpillars come forth and feed for a brief period upon the foliage, previous to their going into winter quarters.

From the smallness of the caterpillars and the age and condition of the leaves it is clear that this is not the time when the pests do their worst work. The caterpillars either spin leaves together and, ensconcing themselves in them, fall to the ground with the leaves, or they drop to the ground and get just under its surface. Where currant bushes grow against walls and fences in gardens, a favourite place for the larvæ to hibernate is in any crack or crevice between the bricks or boards. They also winter amongst the dead leaves that get caught up in the forks and burrs of the bushes. They thus remain in the larval state until the early spring, when they ascend the bushes, and proceed to devour the young and juicy leafage, doing at this time the greatest damage. The wintering larvæ are about half an inch long and much darker than the adult. When full fed, which is generally in late May and June, they turn into chrysalids in a light cocoon, and the moths emerge in due time and place eggs upon the leaves of the gooseberry and currant bushes during August.

Methods of Prevention and Remedies.

1.—Warning is given of a coming attack of this insect by the appearance of the caterpillars in the autumn upon the gooseberry and currant bushes, showing that infestation may be expected in the following spring. When the caterpillars have been thus seen in the autumn, the ground beneath the bushes should be covered with finely powdered quicklime and dug deeply in the early days of winter. The fruit bushes should be previously pruned in order that any caterpillars that have "spun up" on the branches and shoots may be cut away or dislodged. If it is found after pruning that there are many caterpillars on the bushes it would pay to hand-pick them. All the cuttings from infested bushes should be collected and burnt. Washing with caustic alkali wash would destroy those hibernating in the forks.

2.—In the early spring, and before the leaves appear, the ground round the bushes should be hoed, the soil pulverized with prong hoes, and more lime, or a mixture consisting of two bushels of lime to one of soot, applied.

3.—Hand-picking may be also adopted in the spring in gardens and on small fruit farms where the infestation is serious. But in large plantations spraying should be the remedy.

4.—As the caterpillars of the Magpie Moth, like all larvæ of Lepidoptera, are mandibulate insects, they should be destroyed by poisonous sprays such as arsenates. For this, either Paris green or arsenate of lead may be used.

These sprays must not, of course, be employed on ripe or ripening fruit, but may be safely used at any time four weeks before the fruit is gathered. In the case of attack of the Magpie Moth caterpillar, the earlier the spraying is carried out the better, after the leaves have commenced to show. What would be better still in gardens and plantations where this pest occurs would be to give a heavy arsenical spraying in the autumn, about the first or second week in September, so as to kill the young larvæ soon after their exit from the egg, when they are most delicate.

Paris green may be used at the rate of 1 lb. to 200 gallons of soft water in the autumn ; in the spring at the rate of 1 lb. to 250 gallons. The spray fluid should be kept well mixed.

Arsenate of lead is prepared in the following way :— Dissolve 4 ozs. pure arsenate of soda in a little water ; then dissolve 12 ozs. of white commercial acetate of lead in water ; then add the dissolved arsenate of soda to 100 gallons of *soft* water, mix well, add the dissolved acetate of lead, and thoroughly stir. To this add 2 lbs. of treacle. These arsenical sprays should not be used in bright sunshine or when the blossom is out, or for four weeks before the fruit is picked.

5.—Washing with quassia and soft soap has been tried, but is not of much use in caterpillar attack.

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BOARD OF AGRICULTURE AND FISHERIES.

Warble Flies (*Hypoderma lineata*, and *H. bovis*).

Fig 1

Fig. 3.

Fig. 2.

Fig. 4.

Fig. 1. Adult fly, *H. bovis*. Fig. 2. Puparium of *H. bovis*. Fig. 3. Puparium of *H. lineata*, shewing 'lid' (*a*). Fig. 4. *a*. Eggs of *Hypoderma lineata* on hair, magnified. *b*. Eggs still further magnified; x, clasper.

For many years past the Ox Warble Fly has been recognised as a serious pest in Great Britain. The damage done to the hides of cattle is enormous, a point to which the exhibits at certain Agricultural Societies Shows have recently drawn attention.

The Warble Fly that was supposed to occasion this loss was said to be the *Hypoderma bovis* (Degeer), but although this species occurs in this country it may not be the chief culprit. The common warble fly is probably *H. lineata* (Villiers), and from observations made during the year 1902 the greatest amount of damage seems to be done by this species.

The damage caused by these pests is due both to the adult flies and to their larvæ or 'bots.' The flies, when on the wing and on the look out for a host on which to deposit their eggs, frighten stock and frequently cause loss amongst 'in-calf' cows by making them stampede about the fields. The galloping about is also bad for milch cows not only because it affects adversely the secretion of milk, but also because of the bruising of the udders due to their striking against the body. The maggots or 'bots' living beneath the skin are a source of irritation to the cattle, while there is also loss from hides ruined, by the perforations, for tanning purposes. They also cause loss to the butcher, who often finds the flesh beneath the 'warbled' areas so altered by the inflammation set up by the parasites that the beef in that region is spoiled. This so called 'licked beef' has a straw-coloured, jelly-like appearance in a newly slaughtered carcase, but turns to a dirty green in a few hours.

Description.

The *Oestridae*, to which these Warble flies belong, comprise a family of two-winged flies or Diptera, all of which are parasitic in their larval stage, upon or within various mammals.

Hypoderma lineata.—The egg is of a peculiar shape (Fig. 4) and is about $\frac{1}{12}$ of an inch long.

The mature larva or bot is greyish-brown with grey stripes and is about an inch in length, the body being very spiny.

The perfect insect is half an inch long, very hairy, black, clothed with almost white, reddish-brown, and black hairs; there are white hairs on the head and thorax and forming a band at the base of the abdomen. There are also blackish-brown hairs on the upper part of the head, the thorax, the legs and the middle region of the abdomen.

The 'bots' of *H. bovis* are easily distinguished from those of *H. lineata* by the two last segments of the body being free from spines, whilst in *H. lineata*, the last segment only is bare. The mature bot of *H. lineata*, when it leaves the host, is greyish-brown, striped with grey or white; in *H. bovis* it is brownish and much more contracted and

rounded. The adult *H. bovis* (Fig. 1) differs in regard to colour and size, being slightly larger than *H. lineata* and banded with yellow and velvety black hairs, not brownish-black as in *H. lineata.* Like the former it appears from May to September.

Life History.

The life history of *Hypoderma lineata* is as follows :— The fly deposits her eggs upon the hair of the beast, particularly on the legs, just above the hoofs, whence a common name for this fly in America—the heel-fly ; but they are also placed elsewhere. The eggs are fastened to the hairs, usually several together ; each egg is firmly attached to the hair by a process which clasps the hair immediately the egg is laid by the female. The animal licks the place where these eggs are placed, and the larvæ hatched from them are carried by the tongue into the mouth. The young maggots which are spiny pass into the gullet or œsophagus and soon penetrate its walls. They then moult their skin, becoming smooth, and proceed to wander through the connective tissues of the host and between the skin and flesh to the back, under the hide of which they are at last found. Here they moult again, once more becoming spiny. At this stage they commence to produce considerable irritation, and a swelling arises over them—the warble—which soon becomes perforated by a hole at the summit. The tail end is pointed towards this aperture, the two spiracles or breathing pores situated on it being placed close to the opening. There is now formed much pus, upon which, together with blood, the larval bot feeds and develops. A last moult takes place before maturity. By means of the spines the maggot makes its way out of the warble-cell and falls to the ground.

The larva then enters the pupal stage, which may take place either in or on the ground, or under some stone, &c., lying upon the ground. The puparium, or pupa-case, is formed by the bot's old skin, which hardens and gradually becomes almost black in colour. In from three to six weeks the fly escapes from this case, through a circular opening or cap in the puparium (Fig. 3).

This fly appears in Great Britain from the middle of May until the beginning of September

The life history of *H. bovis* is not known with certainty. It may be the same as *H. lineata.* It is said however to lay its eggs on the upper parts of the body. According to Miss Ormerod the maggots from these eggs, aided by mouth hooks and spines, bore directly through the hide. These grow into the mature bots and cause warbles similar to the former species.

All these *Oestridae* are found on the wing during hot, bright weather only. They are most active during the

hottest part of the day, usually between 12 and 3 o'clock. They do not fly in dull cold weather, but become torpid, sheltering in crevices of sheds, hurdles, under leaves, &c. So susceptible are they to temperature that they will not fly into shade or over water. The adults have their mouth parts either quite abortive, or rudimentary, and hence may take little or no nourishment. They produce when flying a low audible hum, which causes the animals to stampede and to seek shelter.

Prevention and Treatment.

1.—Much good may be done by allowing stock to have plenty of shelter during hot weather, either natural shelter of trees or artificial shelter formed by rough lodges or sheds.

2.—The proximity of water, which the stock can enter at will, is also useful as a means of warding off the pest.

3.—The flies may be deterred from laying their eggs by dressing the beasts at intervals of a month, from May to September, with some strong smelling oil or grease. Cart grease and paraffin may be used for this purpose. Another mixture found of benefit is 1 quart of train oil, 4 ozs. of oil of tar, and 4 ozs. of flowers of sulphur.

4.—If animals are found to be warbled the 'bots' may be squeezed out of the swellings and killed during February, March, and April. The maggots may be very easily extracted by squeezing the warbles with both thumbs, and may then be squashed under foot. This is a better plan than covering the opening of the warble with grease or mercurial ointment, so as to suffocate the bot within.

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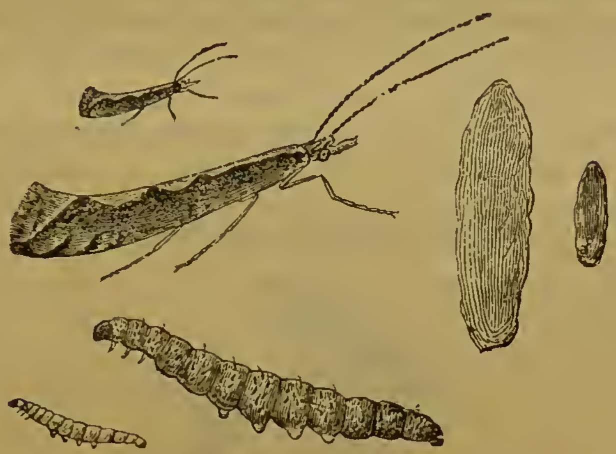
BOARD OF AGRICULTURE AND FISHERIES.

The Diamond-back Moth (*Plutella maculipennis*, Curtis).

FIG. 1.



The moth and caterpillar, natural size, and magnified. The cocoon, natural size, and magnified.

The caterpillars of this pretty little moth have in some seasons caused considerable injury to turnips, swedes, cabbages, kale, and other plants of the group *Brassica.* The caterpillars congregate upon the leaves, on their under surfaces for the most part, and soon devour every particle of their soft tissues, so that either the plants are killed outright or they are so much injured that the crop is materially reduced. A field of turnips or swedes badly infested with these caterpillars has a most peculiar and ghastly appearance, especially when the sun shines upon the riddled and whitened leaves.

This insect has been noticeably injurious to the turnip crop in Great Britain in 1837, 1851, 1883, and 1888. In 1891, however, there was a most serious attack both in England and Scotland, principally in the eastern counties, from Kent to Aberdeenshire. There were attacks in many other parts of Great Britain in 1891, but not nearly of the same gravity and extent as in the eastern districts, where whole fields of turnips, swedes, rape, and cabbage were completely ruined by the hordes of caterpillars infesting their leaves. Cabbages particularly were sadly affected by these pests; they swarmed between the leaves covering the "hearts," and soon caused them to rot. In 1901 also the caterpillars did much damage from July onwards.

The first notes of alarm with regard to the grave infestation of 1891 were heard about the beginning of July, and by the middle of that month great anxiety was felt by many farmers as to the fate of their turnip and cabbage crops, for the caterpillars were clearing everything before them with startling rapidity. On account of their increasing ravages the Board of Agriculture made an exhaustive inquiry into the circumstances and extent of the attack, and instituted a series of special experiments as to the value of various remedial measures which were conducted in different parts of the most seriously infested districts towards the end of July.* Fortunately, about that time and during the first part of August, heavy and continuous rain fell, accompanied by low temperature, which caused fatal disease in the caterpillars, or washed them from the plants, and checked their progress. The rain at the same time stimulated the growth of the plants.

Description of the Insect.

FIG. 2.

Moth flying, natural size; Moths resting, natural size; Caterpillar and cocoon, natural size

The Diamond-back Moth belongs to the family *Plutellidæ* of the extensive group of moths known as *Tineina*. It has been wrongly known for years as *Plutella cruciferarum*, Zeller, but Curtis had previously described it in 1831 under the name *maculipennis*. It is from five lines to half an inch long when resting with folded wings, as shown in two of the figures. The wings when expanded have a breadth of nearly two-thirds of an inch. The prevailing colour is light brown shaded with grey, with the "diamond" marks plainly visible upon the back when the moth is at rest. The hind edge or margin of each fore-wing has three white marks, and these, on the margins of the wings being brought together when the moth is at rest, form the diamond marks. In this position of rest the peculiar tilt of the wings at their ends, forming a kind of tuft, is a notable characteristic. In

* Special Report on the Attack of the Diamond-back Moth Caterpillar, 1891.

some specimens the grey or ashy grey shades prevail over the brown. The under surface of the body is of a grey or pale grey hue.

The fore wings, shown expanded in Figure 2, are greyish brown with dark spots. Along the inner margin of the fore wings there is a border of light colour. The narrow hinder wings are more silvery-grey and have long fringes. The moth has greyish legs, and long slender antennæ of a white colour.

The egg is white or yellowish white, cylindrical, and marked with elaborate and most delicate tracery.

The caterpillars are half an inch long. They have 16 feet and are green in colour, with greyish heads when full grown, but in their early life are grey with dark heads. Their bodies are somewhat "spindleshaped," as Curtis puts it: that is, they taper off at the head and tail ends. Upon some of the segments of their bodies there are a few bristles.

The chrysalids are enwrapped in creamy yellow cocoons, of a fine net-like texture more or less open at each end, one end being closed by the cast larval skin. Stripped of the cocoon the chrysalis is white or yellowish white, with dark marks upon it, at least, in its latest stages. In the earlier stages the colour is darker.

Life History.

In the spring the first brood of moths comes from the chrysalids which have wintered upon the stalks and dead leaves of weeds, such as Charlock, Hedge Mustard, Jack-by-the-Hedge, and similar plants, upon *Cheiranthus* or wall-flower, especially the common variety, which grows freely upon cliffs by the sea, and also upon the Prickly Saltwort, *Salsola Kali*, a common seashore plant. The chrysalids, snugly packed in silken cocoons represented in the figures, are also found on dead stalks and rubbish near the food plants of the caterpillar. When the first brood of moths appears, the females lay eggs upon the under sides of the leaves of wild cruciferous plants, and on the leaves of such cultivated varieties of them as are then growing. There is no reliable record as to the time when the caterpillar comes from the egg, but the caterpillar stage lasts from 20 to 28 days, and the chrysalis stage of the first broods about 15 days.

Curtis and some other authorities hold that there are more than two broods, or generations, of this insect if the weather is favourable; this was demonstrated in 1891, and it may be concluded that there are two and more broods in a season if the conditions of climate are suitable. Food supply is only a secondary condition affecting the multiplication of these insects, as there are so many plants upon which the larvæ may be supported; for instance, all kinds of turnips, all kinds of cabbage, broccoli, Brussels sprouts, kale, rape,

mustard, wild mustard, radishes, horse radish, stocks, wall-flowers, rockets, penny cress, shepherd's purse, scurvy grass, and wall mustard, all of which are crucifers, and on saltwort, which belongs to the Chenopodiaceae.

Remedies and Methods of Prevention.

1.—From the experiences of 1891, and as the result of many experiments carried out then, dressing the infested plants with soot and lime mixed together appears to be the best remedy.

This should be put on by means of a distributing machine, at the rate of from two to six bushels per acre, the proportions being one part of lime to three parts of soot. This pungent substance should be distributed with regularity and force over, through, and under the leaves, and upon the bodies of the caterpillars.

2.—Sprayings with pungent substances, such as carbolic acid and paraffin, applied with a distributing machine in the smallest quantities, or paraffin emulsion in larger quantities, have been found to be efficacious in some degree, but not so effectual as soot and lime.

3.—Soot and sulphur, in the proportions of one bushel of soot to three or four pounds of sulphur, put on at the rate of from two to four bushels per acre by a distributing machine, have been found useful in some cases.

4.—Broadcasting soot and lime, or soot and sulphur, upon infested plants checks the caterpillars to some extent. This must be done when the dew is upon the plants, and much larger quantities are required per acre than when a distributing machine is used. It is, however, not very satisfactory, as the mixture does not go under the leaves, where the caterpillars are.

5.—Horse hoes with branches of birch, green broom, furze, or any elastic boughs, fastened to their sides, may be drawn between the rows advantageously, so as to brush the plants and dislodge the caterpillars upon them. Another horse hoe should follow at once to bury or crush the dislodged caterpillars.

6.—When plants are found to be infested, nitrate of soda, guano, or other forcing manures should be applied to stimulate growth.

7.—After an attack of this insect it is most desirable to brush hedge sides and hedge rows, ditches, and other places harbouring weeds, in the early spring, as it has been noticed that the attack has often been commenced in corners and other parts of fields bounded by hedge rows, and has spread over the fields. Many of the moths may be often seen around cruciferous weeds on the hedge sides. Charlock is a favourite resort of these insects.

Natural Enemies.

In 1891 it was noticed that many of the caterpillars of the Diamond-back moth were attacked by parasites and destroyed by other insects.

Foremost among these was a species of the *Ichneumonidæ* called *Limneria gracilis*, Gravenhorst.

FIG 3.

Limneria gracilis, Gravenhorst: Male and Female Flies, natural size and magnified.

The female fly places an egg in the body of the caterpillar, upon which the larva from this egg feeds. The late Mr. Stainton, writing in August 1891, concerning the great number of the parasites that were in evidence, said: "Probably the parasites of the Diamond-back moth will this "year be developed in such numbers that the moth will be "almost annihilated in 1892."

It was noticed in 1891 that various kinds of birds were effective enemies of the caterpillars of this moth. Among these were rooks, starlings, peewits, golden plovers, and sea-gulls, and it was stated that where small birds had been exterminated the damage was worse. This is one more reason for endeavouring to preserve harmless and useful birds.

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BOARD OF AGRICULTURE AND FISHERIES.

Potato Disease.

(*Phytophthora infestans.*)

The first sign of the disease is the presence of yellowish spots on the leaves; these spots gradually increase in size and become brown; this is followed by the curling of the leaves. If the under surface of a diseased leaf is examined with a magnifying glass, the fruiting branches of the fungus will be seen forming a delicate white mould.

The spores of the fungus are exceedingly minute and are scattered by wind, or by ground game or other animals running amongst the plants. When it is remembered that every spore brought into contact with a damp potato leaf is capable of starting a new centre of infection, the rapid spread of the disease under favourable conditions can be readily understood. The disease develops and spreads with the greatest rapidity during damp, warm weather, such as often occurs about midsummer.

Spores that fall to the ground are washed by rain through the soil and infect young potatoes, especially those growing near the surface. The mycelium of the fungus also passes down diseased stems into the young potatoes. If the season is wet and warm, the mycelium present in the potato continues to grow, soon causing brown spots to appear, and ending in the rotting of the tuber. On the other hand, if potatoes that are infected are kept dry, the mycelium in their substance remains stationary until the following spring, when it commences growth and passes along the "sprouts," finally appearing in the fruiting condition on the leaves.

Several other fungal diseases of potatoes exist and in some cases do more damage than the typical "blight," but the same mode of treatment applies to all.

Means of Prevention and Remedies.

Potato disease is practically wholly propagated and carried on from season to season in the sets themselves. It is therefore of the first importance that seed should not be saved from diseased fields and that it should be stored under the most favourable conditions. In an ordinary way seed potatoes should be carefully selected and all those rejected that show the least sign of taint; they should be allowed to get thoroughly dry before clamping and should be stored separately from the ware. Any diseased haulm should be removed and burned before the potatoes are lifted.

It is observed that varieties that have been long in cultivation contract the disease more easily than many of the newer sorts. A frequent change of seed is also desirable because of the extra vigour thus obtained.

The rows of potatoes should be well "earthed" or "banked" up, as the thicker the layer of soil the less chance is there of the spores of the fungus reaching the young tubers.

Neither disease-resisting varieties nor cultivation can be trusted entirely to ward off the disease in a wet season, but spraying with various preparations of Copper has been found effective and is now part of the regular routine of cultivation in humid districts like the West of Ireland. Even in dry seasons when no disease is apparent the treatment is found to be beneficial, producing a longer period of growth and an increased yield. This is so generally recognised that spraying has become universal in the potato growing districts of the Lothians, whatever the season promises to be. As the disease does not as a rule make much headway before the end of July, spraying is not wanted for the first and second early sorts whose leaves will be dying down before any great harm is done.

Any of the following recipes can be followed.

Ordinary Bordeaux Mixture.

Sulphate of Copper or "bluestone"	...	12 lbs.
Quicklime ...	... ...	6 lbs.
Water	... ...	100 gals.

In purchasing the Sulphate of Copper care should be taken to demand a product of 98 per cent. purity, material offered as "agricultural" Sulphate of Copper being avoided.

The usual adulterant of Sulphate of Copper is Sulphate of Iron, which is much cheaper but entirely ineffective for the present purpose. An easy test for the presence of Iron in the Sulphate of Copper is to dissolve a little in water and add Ammonia with constant stirring until a deep blue liquid forms; any quantity of brown flocks floating about in this blue liquid indicates the presence of so much Iron that the material should be subjected to a proper analysis previous to rejection.

The Sulphate of Copper should be dissolved in the bulk of the water; but, if it is thrown in lumps into the bottom of the vessel it will take a long time to dissolve. Some people powder it (or it can be purchased in powder) and make the solution by stirring it up with a small quantity of hot water, but the easiest way is to tie the Sulphate of Copper in a piece of canvass and hang it near the top of the water. The vessel in which the Copper Sulphate is dissolved must be of earthenware or wood. A paraffin cask is useful for the purpose, but galvanised iron would be attacked by the solution.

The Lime is to be slaked in another vessel (an ordinary galvanised pail will do), made up into a thin cream with water, and then poured through a sieve or a piece of sacking into the solution of Copper Sulphate. Now add the rest of the water and well stir.

It is essential to have sufficient Lime present to precipitate the whole of the Copper; if any remains dissolved it will burn the foliage. Secure freshly burnt lime and if possible obtain white "fat" lime made from mountain limestone or chalk, the kind of lime which is used by plasterers. If only gritty "thin" limes can be obtained it is better to follow one of the other recipes without lime. In any case it is wise to test the mixture to see there is no dissolved Copper present. To do this obtain an ounce of Potassium Sulphocyanide. Allow the Lime and Copper Mixture to settle a little and dip out some of the perfectly clear liquid at the top in a teacup; into this drop one crystal of the Sulphocyanide and stir up with a clean stick or spoon. If any Copper be present a deep chocolate red colour will result, which means that more milk of Lime must be added to the mixture.

The mixture should be well stirred up before it is poured into the sprayer, which should have a dasher of some kind to stir the material during spraying. The mixture will keep several days, but the longer it remains unused the more difficult it is to distribute it properly with the sprayer.

Modified Bordeaux Mixture with Treacle.

As the ordinary Bordeaux Mixture is easily washed off there is an advantage in adding some sticky substance, especially in showery weather. Treacle is perhaps the best, but it is very little good to add Treacle directly to the mixture previously described. A better preparation is to take a little more Lime, 10 lbs., for the 12 lbs. of Sulphate, slake it, and mix with hot water, then run in 10 lbs. of Agricultural Treacle or any cheap sugar; stir up well, heating if possible, until the Lime and Treacle have combined, and pour the mixture into the Copper Sulphate solution as before. This time a green solution of Copper Saccharate will be obtained, but by the action of the air it will precipitate Copper Carbonate. This mixture is very effective but must be used soon after making up.

Bordeaux Mixture with Soda instead of Lime.

Copper Sulphate or Bluestone	12 lbs.
Washing Soda or Soda Crystals	15 lbs.
Water	100 gals.

Follow the instructions given above, using the solution of Washing Soda instead of the Lime and Water.

"*Cupram.*"

Copper Carbonate	10 oz.
Ammonia (Liquor Ammoniae fortiss. 880)	5 pints.
Water	100 gals.

Add the Ammonia to four or five gallons of water and throw in the Copper Carbonate little by little, stirring

vigorously until dissolved. Then dilute with the rest of the water. A clear blue solution results which is advantageous in never clogging the nozzles of the sprayer. This mixture can be made up and kept in the concentrated form until required for use. It is particularly suited to fruit trees and work under glass.

The strength of any of the above mixtures can be varied; up to 20 lbs. of Copper Sulphate with a proportional amount of Lime may be used for 100 gallons of water, but a mixture of this strength should only be used on mature plants with fully developed leaves.

Sulphate of Copper compositions are poisonous, and the tubs, pails, or other vessels which have contained Bordeaux Mixture, or in which it has been made, must therefore not be used for farm animals.

Application of Bordeaux Mixture, &c.

The quantity to be applied per acre is about 120–150 gallons, where the foliage is fully developed; it might be somewhat less in the earlier stages of growth. The plants should be sprayed from underneath, as well as from above, so as to reach the fungus on the under sides of the leaves. Machines can be obtained which spray the plants from below.

The cost of a single spraying need not exceed 8*s.* per acre, and, with certain horse machines, 30 acres can easily be treated in a day. The operation should be done before any symptoms of disease show themselves, say towards the end of June, or early in July according to the locality and season. The first spraying should be as soon as there is a good development of haulm, the treatment to be repeated about three weeks later when the growth is complete. If only one spraying is given it should take place about the middle of July. Early blight (leaf curl) which comes in dry seasons when the plant is only a few inches high should be treated in the same way.

4, Whitehall Place, London, S.W.,
Revised, October, 1904.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

DISEASED LEAF AND TUBER OF POTATO.

BOARD OF AGRICULTURE AND FISHERIES.

The Ribbon-Footed Corn-Fly.

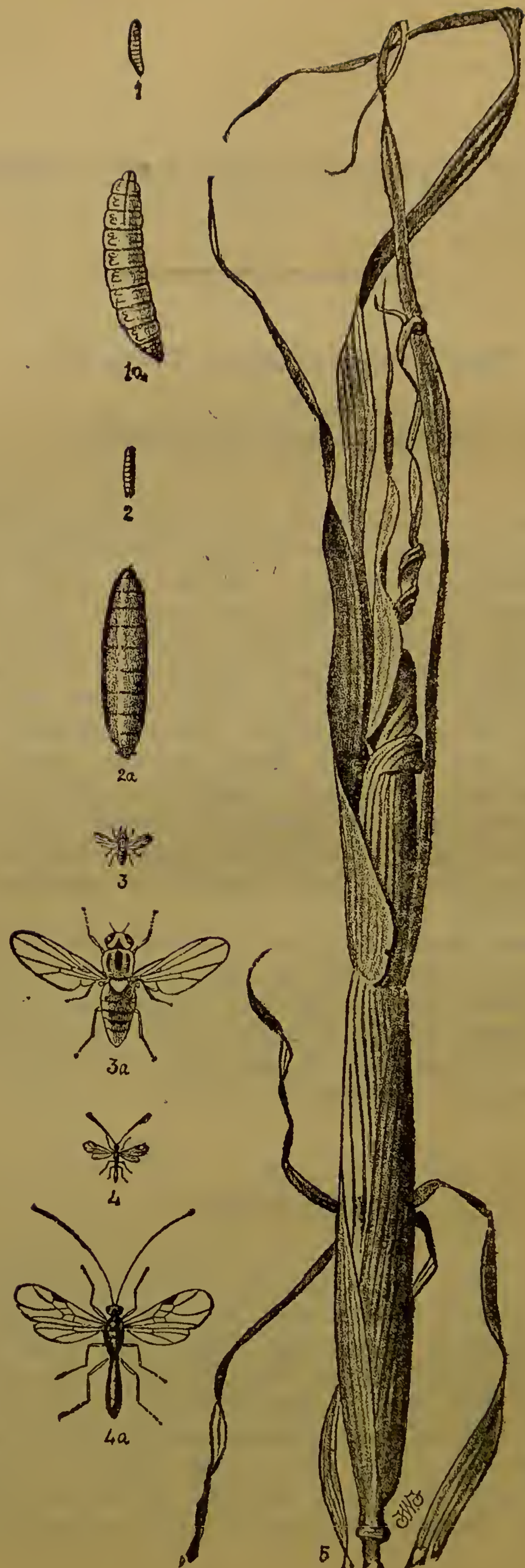
(*Chlorops tæniopus*, Meigen).

The larvæ, or maggots, of the Ribbon-Footed Corn-Fly, which is sometimes termed the "Gout Fly," cause an immense amount of harm to wheat and barley plants in some seasons. In 1893, particularly, the injury it occasioned to the barley crop was most serious, mainly because the plants were kept in a backward condition by the extreme drought, so that they could not grow away from the attack of the larvæ within them. Many hundreds of acres of barley were fed off with sheep, as the plants were so injured that they could not possibly recover and yield a crop. In many cases the yield of infested fields was next to nothing, the plants being stunted and distorted, as shown in Fig. 5, and the ears were unable to emerge from the sheathing leaves.

Upon examination of plants infested with these larvæ, it will be seen on taking off the sheathing-leaves that the ear within is eaten away at its base, and that a furrow has been made from this point right down the ear-stem to the first joint. At this part, or near this part, either the larva or the brown pupa case may be found.

Life History.

The fly is very small, being only about one-sixth of an inch long (Fig. 3 natural size, Fig. 3*a* magnified). It has three black bands down the back, and four transverse stripes on the upper side of the abdomen. The male is of a light yellow hue, and is rather smaller than the female, which is of a somewhat greener colour. The eyes of the fly are large and green. The eggs, which are long, cylindrical, and greenish-white, are laid in May—early or late, according to the weather—upon the leaves which serve as


1
1a
2
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sheaths of the forming ear. The larva (Fig. 1 natural size, Fig. 1*a* magnified) has no legs; it is white, becoming slightly yellow in time, and is about one-fifth of an inch in length. It has two spiracles at the end of its body, and two hooks at its head.

When the larva comes from the egg, it pierces its way through the leaves directly to the base of the ear, and feeds upon its juices, checking its growth, and preventing it from pushing up through the leaves. Before the larva pupates, it makes a channel, or furrow, down the stem of the ear to the first joint, and changes to a chrysalis there, or in the folds of the sheathing-leaves. In some cases, when the weather is forcing and the plants are pushed on by manure, the attacked ear has vigour enough to escape from its sheath and to produce some corn. But in seasons like that of 1893 the plant has not sufficient vitality and vigour to force the ear out of its leafy envelope and away from the larva.

There is not more than one larva in a stem. This, however, in conditions unfavourable to the growth of the plant, is quite sufficient to spoil the produce of one ear. In many sheath-bound ears examined in 1893, it was astonishing to note the immense amount of mischief one larva had been able to accomplish.

The duration of the larval state varies according to circumstances. The puparium is brown, somewhat flattened, and about the same length as the larva (Fig. 2 natural size, Fig. 2*a* magnified). It changes to a fly in about a fortnight, at least in confinement.

There are two or more broods of this insect during the year. The eggs of the late generation of flies are deposited upon grasses, and upon early-sown wheat and winter barley. It was only ascertained positively in 1890 that these crops were infested in this country in the autumn, though it has been long known that the Ribbon-Footed Corn-Fly passes the winter in corn plants in Germany, Holland, and France.

The attack of this pest is usually worst in badly drained parts of a field and along water-ways and ditches; also near the grassy head lands and along the edges of the fields.

Methods of Prevention and Remedies.

The only methods of prevention appear to be (1) to keep land clean from couch-grass and other common grasses which harbour the insect, (2) not to put winter wheat or barley close to fields that have been infested, (3) not to sow so early in autumn as to enable the flies to lay eggs on the plants. Though the flies have ample wings they do not fly far. Early spring-sowing in infested districts

is desirable, as it gives the plants a chance to grow away from the attack.

Nothing can be done in the way of remedies but to stimulate the infested plants with liberal dressings of nitrate of soda, or sulphate of ammonia, in order to encourage rapid growth, and to force the ears from the sheaths.

Natural Enemies.

From a large percentage of the pupa-cases of the Ribbon-Footed Corn-Fly kept in glass-covered boxes, a parasitic hymenopterous fly came forth. This fly (Fig. 4 natural size, 4*a* magnified) is known as *Cœlinius niger*, a pretty brown insect about a quarter of an inch long, with brilliant wings. In the body of the corn-fly larva it places an egg, from which a larva is hatched, and feeds upon its host.

There is another fly, *Pteromalus micans*, which is parasitic in a similar manner upon the Ribbon-Footed Corn-Fly, and is described by Curtis as being very destructive to it.

4, Whitehall Place, London, S.W.
August, 1893.

Revised, May, 1903.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Chafer-beetles *or* White-grubs.

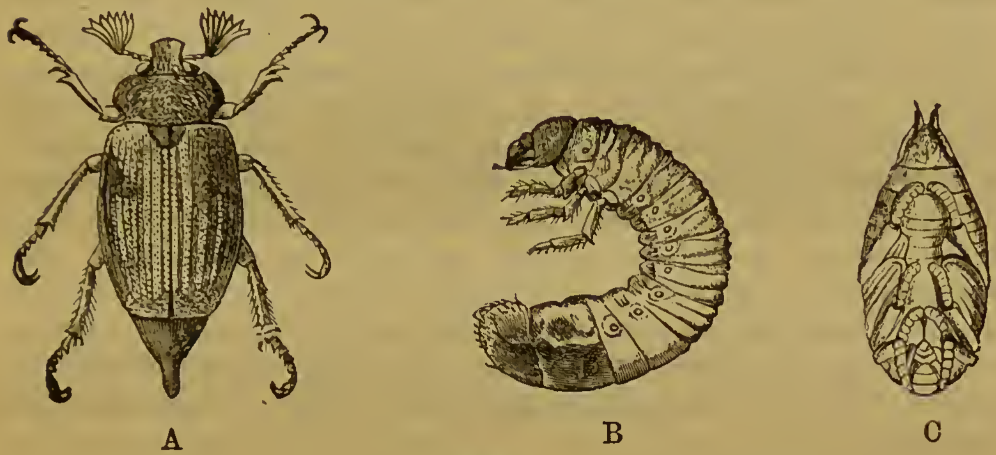

Fig. 1.

The Large Cockchafer (*Melolontha vulgaris*).

A. Perfect insect; B. Larva; C. Pupa. All natural size.

Distribution and Plants attacked.

In the majority of districts in Great Britain "Chafer-grubs" or "White-grubs" are more or less abundant. The damage they do in the larval or grub state is often very serious, but is perhaps more frequently attributed to the work of the wire-worm. Not only do these insects cause loss to the farmer, gardener, and forester by damaging the roots of plants when in the grub stage, but much harm is also done by them when they appear as adult beetles. The beetles feed on the leaves of various forest trees, occasionally quite stripping them of their foliage, particularly broad-leaved species, although conifers are also attacked. Fruit trees are occasionally attacked by them, as also are grass, corn, peas, and many vegetables. It has usually been supposed that this loss is due to the Large Cockchafer (*Melolontha vulgaris*), but this large chafer is no more abundant and harmful than two smaller species known as the Garden-chafer, Bracken-clock or Coch-y-bonddu (*Phyllopertha horticola*), and the Summer-chafer (*Rhizotrogus solstitialis*).

These insects are much more abundant and destructive in France, Germany, and other parts of Europe than in Great Britain; but as during the past ten years they have very materially increased in this country, farmers and gardeners should guard against them wherever possible. The grubs feed on almost any roots, but are particularly prone to attack those of grass and seedling trees. Young oaks and pine-trees

often suffer severely both in this country and on the Continent. The grubs bite the roots, thereby checking the growth of the plants and frequently killing them outright. In grass land, the grass may often be seen dying from the ravages of these pests. Rooks are very fond of white grubs, and are attracted to the fields to feed on them; these useful birds are often unjustly accused of injuring the grass plants, whereas they are really feeding on the chafer-grubs which destroy the grass. The beetles are perfectly easy to distinguish from one another, but the grubs of all three are very similar when young, and can only be identified by microscopic examination. This is a somewhat important matter, as there is a difference in the life-histories of the three species in regard to the time of appearance of the adults and the duration of the grub stage. It is important to notice the time of appearance of the adult beetles, as the pests are then easiest to destroy; they are very difficult to combat when in the grub stage in the ground, especially in grass-land.

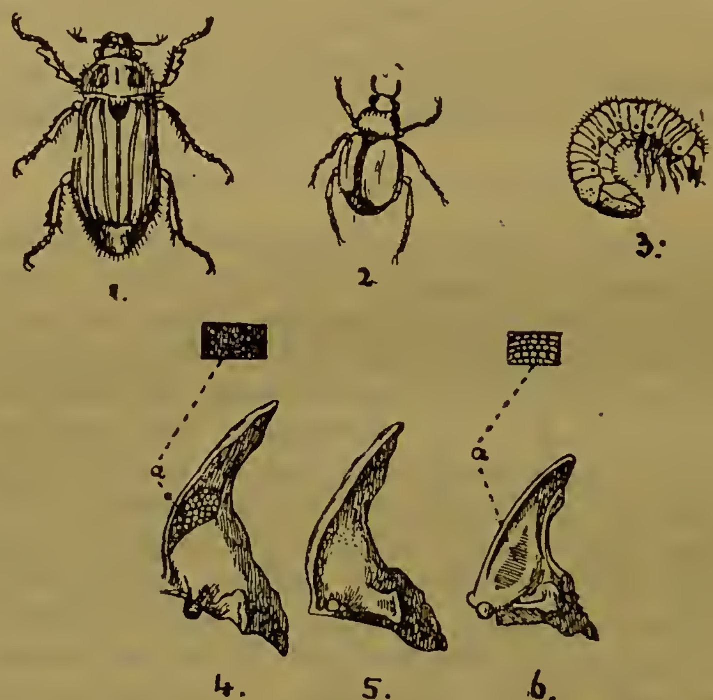

FIG. 2.*

1. The Summer-chafer (*Rhizotrogus solstitialis*). 2. The Garden-chafer (*Phyllopertha horticola*). 3. Larva of the Garden-chafer. All natural size. 4, 5, & 6. Mandibles of larvæ (magnified).

Description.

(1) The *Large-chafer*, usually called the *Cockchafer* (Fig. 1—A, B, C), is often an inch in length, with head and front portion of the body black, the wing cases (elytra) being reddish-brown, hairy, and with five raised lines on each; along each side of the abdomen are five white triangular

* Fig. 2.—4, 5, and 6 are reproduced, by permission of the Society, from the Journal of the Royal Agricultural Society of England, 3rd Series, Vol. VIII., 1897, p. 748.

marks. The abdomen ends in a prolongation, downwardly curved, and not covered by the elytra. The end joints of the antennae form a kind of club, made up in the male of seven leaves and in the female of six.

(2) The *Summer-chafer* (Fig. 2—1) is somewhat smaller, being about two-thirds of an inch long, of a general reddish-brown or yellowish colour, the colour varying. The wing covers have each four raised lines. Fresh specimens are distinctly hairy, and the club at the end of the antennae has three leaves, both in the male and the female.

(3) The *Garden-chafer* (Fig. 2—2, 3) varies from one-fourth to one-half of an inch long, the front part of the body is of a metallic greenish colour, and the wing cases of a reddish-brown hue ; the male is very hairy.

(4) A fourth species of chafer is *Cetonia aurata*, the *Green Rose-chafer*. This beetle measures two-thirds of an inch in length, and is golden green above ; the wing-covers are marked with white specks and streaks.

The garden-chafer appears in June and July, and the summer-chafer about the same time, whilst the large or cockchafer usually occurs in May and June, as also does the green rose-chafer. There are slight differences in the times of flight according to weather conditions.

The grubs are thick, fleshy, and dirty-white, the tail end of the body being swollen and darker in colour ; the head is large and brown, the mouth being armed with strong mandibles, which vary somewhat in each of the three species figured above (Fig. 2—4, 5, 6) ; there are also three pairs of jointed legs on the front of the body. These white grubs lie with their bodies bent, and, although sluggish when taken out of the soil, are comparatively active when in it. In habits and external appearance the larvæ are very similar, but when full-grown there is a marked difference in size ; the grubs of the cockchafer and the green rose-chafer reach one-and-a-half inches in length and are thicker in proportion than those of the garden-chafer and the summer-chafer, which, when full-grown, are distinctly smaller.

The grubs can be further distinguished from one another by the following microscopic characters seen in the mandibles :— In the large-chafer the mandibles have a granulated area (Fig. 2—4, *a*), where the light and dark parts of the jaws unite ; in the summer-chafer the whole surface is very minutely granulated (Fig. 2—5) ; in the garden-chafer there is a pale oval area with file-like ridges across it (Fig. 2—6, *a*). The cockchafer grub can be further distinguished from the garden-chafer grub by the fact that the claws of its front pair of legs are longer than those of the second pair, and those of the second pair longer than those of the third pair, whereas in the grub of the garden-chafer the claws of the front pair of legs are shorter than those of the second pair, and those of the second pair shorter than those of the third.

The larva of the green rose-chafer resembles that of the cockchafer but has a large rusty spot on each side of the first segment behind the head ; its feet, too, are pointed, and the body is covered with transverse rows of short hairs.

Life Histories.

The Cockchafer.—The female burrows into the earth and lays her eggs, 12 to 30 at each laying, and near one another, and up to 70 in all. After five to six weeks the larva hatches out. No great damage is done till the second summer, when the grubs gnaw the roots of grass and agricultural plants and seedling trees, the feeding being continued during a third and a fourth summer, when the grub becomes a pupa in the soil, but the beetle does not appear above ground for egg-laying till the next May, *i.e.*, a new generation of beetles may, in our climate, be expected every four years. The cockchafer flies towards night, resting sluggishly during the day on trees.

The Summer-chafer has a similar life-history, but the grubs are destructive more to agricultural plants than to young trees. The beetles rest in the daytime and fly in the evening. They sometimes appear in thousands. There is not complete agreement as to the length of the life cycle, but very probably it can be completed in one year. The swarming of the adults lasts for only a few weeks, and may, under similar weather conditions, be expected at the same time in the next year.

The Garden-chafer.—This beetle flies in the bright sunshine, and often in great swarms. The mature beetles strip trees of their leaves, and are destructive to turnips, peas, and garden plants—*e.g.*, roses. Young fruits are also attacked. The grubs are especially harmful in grass land, the roots being bitten through. There is one generation during the year.

The Green Rose-chafer also flies in the daytime in bright summer weather, resting sluggishly during dull days. The adults are harmful to leafage and especially to flowers—*e.g.*, strawberry and other rosaceous plants, turnips, &c.,—the stamens of flowers being destroyed by the biting off of the anthers. An interesting point as compared with other beetles is that during flight the wing covers of this species are not spread, but only slightly elevated so as to allow the spread of the two hind or flying wings. The eggs are laid in the ground, in rich garden soil ; the grubs have also been taken from the rotting wood of tree stumps. Pupation takes place under cover of a cocoon of earth the exterior of which is rough. Two or more years may be required to complete the life cycle.

In certain years these beetles are noticed to be more abundant than usual. These "chafer-years" are fairly regular, occurring every fifth year where the large-chafer is commonest, and every year where the garden-chafer and

summer-chafer are most prevalent. It is very important to note the year in which these creatures occur in great numbers, because the next brood can be foreseen and steps taken to destroy the beetles at once. It has been noticed that these insects are somewhat local although wide-spread, certain fields being attacked time after time while neighbouring fields are quite free from infestation.

Methods of Prevention and Remedies.

Remedial measures are most effective during the beetle stage, hence the importance of having accurate data in regard to "chafer" years.

(1.) The best way of preventing the injury caused by these insects and their grubs is to destroy the beetles when they appear upon trees, &c., in the early summer. In France and Germany systematic warfare is waged against these pests, and it is only in this way, and by concerted action on the part of the farmers, that any real benefit will accrue in districts where chafer larvæ are very harmful. A single farmer on a Mayenne estate in France collected 2000 lbs. of cockchafers in the summer of 1889, and as each female may lay as many as sixty to seventy eggs the importance of such wholesale destruction is self-evident. In destroying and collecting the beetles, it should be noted which is the abundant chafer in the neighbourhood. If it be the cockchafer or the summer-chafer then it must be attacked in the daytime, especially during bright weather; and when the weather is dull, or late in the day, if it be the garden-chafer or the green rose-chafer, for these are day fliers and often very active in the sunshine.

(2.) The beetles may be beaten down on to tarred boards from the trees and shrubs by means of long sticks, or they may be collected into sacks, and killed. This should be done, in the case of the cockchafer and summer-chafer, during the day, when the beetles are very sluggish, and when they are found clinging to the lower surface of the leaves. If they are shaken on to the ground, pigs may be employed to destroy them as they are greedily devoured by these animals.

The beetles are best sought for on isolated trees and bushes, as they are said to go into woods only in bad weather. The trees should not be too vigorously shaken, or the beetles may fly away instead of falling down. Attention must be paid to the kind of beetle to be trapped on account of the different times of appearance.

(3.) Trapping the larvæ has also been resorted to with marked success. For this purpose, pieces of turf from eight to twelve inches broad and six to eight inches thick are laid, with the grass downward, on the surface of the ground. The larvæ collect beneath the turf. Heaps of turf, humus, dung, &c., may also be employed as larval traps.

(4.) When the grubs are working in the soil, gas-lime and kainit as "top dressings" have been found of benefit. On pasture land, where the attack is worst of all, a heavy dressing of gas-lime has frequently been used, and is found to kill the grass and the grubs. This seems too drastic a measure; but it must be done thoroughly if any good is to ensue, and the grass grows strongly the following year, almost too strongly according to one report (Ann. Rept. Zool. R.A.S.E., 1894). Dressings of kainit at the rate of 5 cwt. to the acre have been known to do much good on grass land, as has also basic slag at the same rate. The effect of all these dressings, however, depends entirely on the weather conditions. Kainit has a decidedly injurious effect upon soft larvæ; basic slag probably only acts as a stimulant to the plant.

(5.) In the case of corn and pulse crops frequent horse and side-hoeing does some little good, and in the case of garden cultivation soot and lime have been freely employed, but in the latter case hoeing and hand-picking are preferably recommended. Frequent reports are received regarding the garden-chafer on strawberry roots, but little can be done to rid the plants of this pest in the summer. Dressings of kainit, however, or a heavy dressing of soot, might be tried in the early spring.

(6.) The rook, starling, green plover, and the black-headed and common gulls should be encouraged, as they devour large numbers of white and other grubs. The two birds last-mentioned often occur far inland, and may be seen following the plough and greedily picking up any larvæ that are thrown up. The adult chafers are eaten in large numbers by owls and night-jars. Bats also eat them, and moles hunt in the ground for the grubs.

(7.) Attempts have been made in France and Germany to destroy the chafer larvæ by infecting them with fungoid diseases. Two species of fungi have been experimented with—*Botrytis tenella* and *Isaria densa*. Infection is communicable by means of living infected grubs, but not by dead ones. The results are at present not sufficiently satisfactory to warrant the extensive employment of this method of destroying the larvæ.

4, Whitehall Place, S.W.,
April, 1896.
Revised, October, 1904.

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BOARD OF AGRICULTURE AND FISHERIES.

Farmers and the Income Tax.

The Board of Agriculture and Fisheries desire to give publicity to the following Memorandum, compiled under the authority of the Board of Inland Revenue, which sets out the principles upon which assessments to income tax are made in the case of persons occupying lands for the purpose of husbandry only, and the various rights of appeal and relief which exist.

By the exercise of the option (referred to in paragraph No. 4 of the Memorandum) of being dealt with according to the rules of Schedule D. of the Income Tax Acts, occupiers of land for the purpose of husbandry only who have made no profits therefrom on the average of the three years preceding the year of assessment, or whose aggregate income from every source does not exceed 160*l.* a year, are not assessed to income tax in respect of such occupation, provided, of course, that the returns they make on the form which will be supplied to them by the Surveyor of Taxes for assessment under Schedule D. are regarded as satisfactory by the Commissioners of Taxes. In such cases no appeal to the Commissioners is requisite, since no assessment is made, and no question arises involving payment and subsequent repayment of the tax.

Where assessments are made under Schedule B. the law provides ample means of obtaining relief if at the end of the year the farmer has made no profits, or if his profits have fallen short of the sum assessed, but by reason of the fact that the Commissioners of Taxes require the production of accounts before they issue a certificate for repayment, the process is necessarily somewhat troublesome to the farmer. It is for this reason that the making of a return for assessment under Schedule D. would in many cases be a simpler and more advantageous proceeding.

In any case of difficulty arising under any of the heads mentioned in the Memorandum, the Board recommend that application for advice and assistance should be at once made to the local Surveyor of Taxes.

MEMORANDUM.

Income Tax. Schedules A. and B. on Lands used for the purposes of Husbandry.

1. Income Tax is chargeable on the annual value of lands under Schedule A. in respect of the ownership, and under Schedule B. in respect of the profits derived from the occupation. The rate of tax under Schedule A. is 1*s.* on the annual value, less certain deductions, and under Schedule B. it is the same rate of 1*s.* on one-third of the annual value, including Tithe Rent Charge, without deduction.

2. "Annual value" means the rack rent at which lands are worth to be let by the year, that is, the yearly rent which a tenant might reasonably be expected, taking one year with another, to pay for the lands, if the tenant undertook to pay all usual tenant's rates and taxes and if the landlord undertook to bear the cost of repairs and the other expenses necessary to maintain the property in a state to command that rent. The Finance Act of 1894 authorises an allowance from the assessment under Schedule A. of one-eighth part of the annual value of the lands (inclusive of farm-houses, and other buildings if any) as determined by the Commissioners of Taxes for the district.

3. Under the Finance Act of 1896, any owner or other person in receipt of the rent of any lands, although not the occupier thereof, has the same right of appeal under Schedule A. as if the assessment were made upon him.

4. Any person occupying lands for the purpose of husbandry only may elect to be assessed under Schedule D. on the average profits of the three preceding years instead of being assessed under Schedule B. on one-third of the annual value. The election of such person to be assessed under Schedule D. must be signified by notice in writing addressed to the Surveyor of Taxes for the district on or before the 5th of June in each year. In Scotland the time within which notice must be given to the Surveyor is extended to 5th of August.

5. Meetings of the Commissioners of Taxes are held annually between the 29th of September and the 25th of December for the purpose of hearing appeals under Schedules A. and B. and D. In England and Wales intimation of the dates of these meetings is given by notice affixed to church and chapel doors, and any person aggrieved by the assessments made upon him may appeal, on giving 10 days' notice of his intention either to the local assessor or to the District Surveyor of Taxes. In Scotland notice of intention to appeal should be sent to the Surveyor of Taxes for the district within 10 days after receipt of notice of assessment, and thereafter intimation will be given of the place and date of the meeting of the Commissioners.

6. The Commissioners also hold meetings after the expiration of the year of assessment for the purpose of hearing appeals by persons who have paid income tax under Schedules B. or D. on amounts in excess of the actual profits made in that year.

7. Persons who desire to appeal with a view to obtain repayment on the ground of loss or diminution of profits must apply to the Surveyor of Taxes within six months from the 5th of April for information as to the time and place of meeting of the Commissioners.

8. Persons who have sustained a loss by farming operations may obtain a repayment of the tax paid under Schedules B. or D., and also, to the extent of such loss, repayment of tax paid in respect of their incomes (if any) derived from sources other than from occupation of land.

9. The printed form of account of profit and loss for the use of farmers shewn on page 5 has been provided by the Commissioners of Inland Revenue, and may be obtained on application to any Surveyor of Taxes.

10. The Commissioners of Inland Revenue have instructed their officers not to object to the admission of farming accounts made up annually from Michaelmas Day instead of from Lady Day.

11. Under the Finance Act of 1898 any person whose total income from all sources is proved not to exceed 160*l.* is exempt from the payment of Income Tax. Where the Income from all sources exceeds 160*l.*, but does not exceed 400*l.*, the person is entitled to claim an abatement of duty on 160*l.* Where the Income from all sources exceeds 400*l.*, but does not exceed 500*l.*, an abatement can be claimed of the duty on 150*l.* Where the Income from all sources exceeds 500*l.*, but does not exceed 600*l.*, relief can be claimed on 120*l.* Where the Income from

all sources exceeds 600*l.* but does not exceed 700*l.*, an abatement is allowed on 70*l.* Where owners of land make any claim of exemption or abatement, the annual value of the lands assessed under Schedule A. should be taken (for the purpose of the claim) to be the amount of the assessment after deduction of the allowance of the one-eighth mentioned in Paragraph 2. For the purpose of claiming exemption or abatement, the income arising from the occupation of land is (since the passing of the Finance Act of 1896) to be taken at one-third of the annual value, including Tithe Rent Charge.

12. *Remission of Rent.*—Where temporary abatements or remissions of rent have been allowed, a reduction or repayment of duty may be claimed in respect of the amount remitted for each complete year ending on the 5th of April. The allowance may be claimed under both Schedules (A. by the landlord, B. by the tenant) on special forms of claim which will be supplied by the Surveyor of Taxes. When the remission has the effect of bringing the total income to an amount not exceeding 160*l.* the whole of the duty paid or payable will be repaid or allowed.

13. Further information on any of the points mentioned in this Memorandum may be obtained from the Surveyor of Taxes for the district, who will take steps to afford proper facilities to all persons who desire to appeal with the object of obtaining relief from or the repayment of Income Tax.

4, Whitehall Place, London, S.W.,
November, 1894.

Revised, June, 1904.

N.B.—The rate of income tax per pound is subject to yearly revision.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Form of Account of Profit and Loss for the use of Farmers.

INCOME TAX.

No. 79D. Farmers' Appeals.

Parish of__________
County of__________

STATEMENT of PAYMENTS and RECEIPTS in respect of Lands in my occupation for the purposes of HUSBANDRY (particulars of which are entered at the back of this form) for the year ending__________190__.

PAYMENTS :—	£ s. d.	RECEIPTS :—	£ s. d.
†Value of *Stock* (live and dead) and *Produce* at beginning of year ...		Live Stock and Wool sold	
Live stock bought ...		Corn and Seeds sold ...	
Corn and Seeds bought for seed		Dairy Produce and Poultry sold...	
Feeding Stuffs, Oil Cake, and Manure bought ...		Other Produce, including Hay, Straw, or Roots where sold	
Rent [plus Tithe, if any, paid by Tenant in addition to rent]		Labour, Stock, Implements, &c., hired out ..	
The amount of the Schedule A. assessment (*i.e.*, the value assessed, not the Duty paid) if the Occupier is also the Owner		Taking in Sheep or Cattle to graze...	
Rates, Taxes [excluding Income Tax] and Insurance of Farm Stock		†Value of *Stock* (live and dead) and *Produce* at end of year	
Labour on the Farm ...		OTHER RECEIPTS, viz. :—	
*Tradesmen's accounts for Goods supplied, or work done *upon the Farm* ...			
*Sundries		Value of Farm Produce used by Household ...	
£		£	

* Disbursements or Expenses for the maintenance of the Occupier of the Lands or of his family are not to be included.

† This is the value of *Stock* and *Produce* only — not including tillages, &c.

Signature__________
Address__________
Date__________

Form of Declaration to be filled up and signed, when the value of the Stock at the beginning and end of the year cannot be shown in the above Account.

I solemnly and sincerely declare that the amount of live and dead stock and produce (†) upon my holding on§ the_____day of__________190___ did not differ materially for the purposes of this account from the average amount in hand on the corresponding day of previous years [‡ except in the particulars stated below which are true to the best of my knowledge and belief].

§Name the day to which accounts are made up. ‡ Strike out the words in brackets if the amount is the average one.

Particulars of difference referred to above.

Description of Stock and Produce.	Increase.	Decrease.

Signature__________.
Date_____190

BOARD OF AGRICULTURE AND FISHERIES.

Remission of Tithe Rentcharge.

The Board of Agriculture desire to draw the attention of owners of lands used for agricultural purposes to the statutory provision for the remission of tithe rentcharge that is made by section 8 of the Tithe Act, 1891, whereby a remission of such part of the tithe rentcharge on agricultural lands as exceeds two-thirds of the assessment of the lands under Schedule B. of the Income Tax may be obtained under the conditions laid down.

The section provides as follows:—"Where a sum is "claimed on account of tithe rentcharge issuing out of "any lands, and the County Court is satisfied that, if "the sum claimed is paid, the total amount paid on "account of the tithe rentcharge for the period of twelve "months next preceding the day on which the sum claimed "became payable, will exceed two-thirds of the annual "value of the lands as ascertained and entered in the "assessment for the purpose of Schedule B. to the Income "Tax Act, 1853, or as certified as hereinafter mentioned, the "Court shall order the remission of so much, whether the "whole or part of the sum claimed, as is equal to the "excess, and the amount so ordered to be remitted shall "not be recoverable; and if the Court is satisfied that "neither such remission, nor the liability thereto, has "been taken into account in estimating the rateable value of "the tithe rentcharge, the Court may remit such amount of "any then current rate assessed on the owner of the tithe "rentcharge as appears to the Court to be proportionate to "the amount of the remission of tithe rentcharge."

It is to be noted, however, that by sub-section 8, remission is confined to rentcharge on lands used solely for agricultural or pastoral purposes or for the growth of timber or underwood. And where lands were at the commutation the subject of a special apportionment, that is, where the tithe rentcharge in respect of a larger area was, by the desire of the landowner, specially apportioned on a smaller area, so that the smaller area bears a greater proportion of rentcharge than it would otherwise have borne, remission is not to be granted unless the Court is satisfied that the applicant would have been entitled to remission if no special apportionment had been made (section 8, sub-section 6).

The basis of any remission being the annual value for the purpose of assessment under Schedule B. of the Income Tax, it is obvious that, where there is reason to think the provision will apply, attention should first be directed to seeing that the lands are correctly assessed under Schedule B.

If the lands out of which any tithe rentcharge issues are assessed under Schedule B. with other lands, the surveyor of taxes for the parish is, on application of either owner or occupier, to divide the annual value stated in the assessment between the lands out of which the tithe rentcharge issues and the other lands, and give notice of the annual value, as so determined, to the applicant and the tithe owner ; and either of these parties, if dissatisfied, can appeal to the General Commissioners of Income Tax for the division in which the lands are assessed, who will finally determine the proper division of the annual value (section 8, sub-sections 2 and 3).

If in any case the annual value is not ascertained and entered in the assessment under Schedule B., the General Commissioners of Income Tax for the division are, on application of either owner or occupier, to ascertain the annual value for the purpose of Schedule B., and inform the applicant (section 8, sub-section 4).

On payment of 1*s*., the Commissioners of Taxes are to give a certificate of the annual value of any lands for the purposes of section 8. It is important that this certificate should be obtained, since, under Rule 32 of the Tithe Rent-charge Recovery Rules, 1891, its production at the hearing before the County Court appears to be necessary for obtaining remission.

The procedure in the County Court is available only when a tithe owner has given the Registrar of the Court notice of his intention to apply to the Court for the recovery of his tithe rentcharge. Notice of the application is served on the owner of the lands, and if he desires to obtain remission he must, at least five clear days before the hearing, give the Registrar notice of his intention to apply for a remission, and in such notice state whether more than one tithe rentcharge issues out of the lands—*e.g.*, the application may be for rectorial tithe rentcharge, and the land may also be subject to vicarial tithe rentcharge. If there is any such other rentcharge, the owner of it receives notice of the application, so that both rentcharges may be dealt with by the Court at the same hearing.

The procedure in these cases is regulated by the Tithe Rentcharge Recovery Rules, 1891, in the Appendix to which is a form of notice of intention to apply for remission.

These provisions do not apply to rentcharges under The Extraordinary Tithe Redemption Act, 1886.

The Tithe Act, 1891 (price 1½*d.*), and the Rules thereunder, may be obtained of Messrs. Wyman and Sons, Ltd., Fetter Lane, London, E.C.

It may be added that where there is doubt as to the amount of tithe rentcharge charged on any lands, information can be obtained by any person on sending to the Board an Ordnance Survey Map with the lands clearly marked thereon, and on payment of a search charge, which usually amounts to two shillings. If extracts from the tithe apportionment are required there is a further small charge, the amount of which can be ascertained on applieation to the Board.

Copies of forms and memoranda relating to the re-apportionment and redemption of tithe rentcharges may be obtained free of charge on application to the Board.

4, Whitehall Place, S.W.,
December, 1894.
Revised, December, 1905.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of Application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Anthrax.

1. Anthrax has long been known as a generally fatal disease, communicable to cattle, sheep, swine, and also to man. Prior to the discovery of its true cause it was regarded as a disease affecting cattle only, attributed to feeding them on highly nutritious or artificial foods, which induced an attack of apoplexy or enlargement of the spleen, resulting in sudden death. This view as to the cause of anthrax appears still to exist in many parts of the country, for it is a common practice amongst owners of stock, being unaware of its dangerous character, to slaughter their cattle as soon as they present symptoms of serious illness, in order that the carcase and hide may be utilized. The blood of the diseased animal is thus in many cases distributed over the floors of the sheds, or upon the mangers, or is carried upon the boots of the attendants, by which means other parts of the farm or premises become infected.

2. It is important that it should be widely known that the disease is solely due to the introduction, into the blood of an animal or of man, of the minute spores or germs contained within the anthrax bacilli, which are to be found in the blood of animals recently dead of anthrax soon after it has been exposed to the air. On the other hand the bacilli of anthrax and the spores therein die speedily if kept within the intact carcase.

3. It will thus be recognised that in order to prevent the extension of anthrax from diseased to healthy animals or to persons, it is essential that the carcase of the affected animal should not be opened, and that none of the blood or the excretions which may contain blood should escape, as the spores contained within the blood will, when exposed to the air, multiply with rapidity, and may become the means of infecting other animals.

4. In most instances, the first intimation of an outbreak of anthrax is the discovery of a dead animal in the pasture or byre. The animal may have been left a few hours earlier in

apparent good health ; at least, there may have been nothing to attract attention, or give warning of the near approach of death. Occasionally there are, however, premonitory symptoms of an attack of anthrax which can be recognised by an expert. The affected animal is dull, and disinclined to move. If the case occurs in a herd at pasture the fact is sometimes indicated by the separation of the sick animal from the rest. The affected animal will occasionally cease to feed, and stand with its head bent towards the ground, and sometimes a little blood is discharged from the nostrils and also with the fæces. Close attention will enable the observer to detect an occasional shiver and trembling of the limbs, which passes rapidly over the body, and then ceases. The shivering fits may then become more frequent, and perhaps, while these signs are being noted, the animal will suddenly roll over on its side, and, after a few violent struggles, expire. On close inspection, especially in the case of swine and horses, it will often be found that there is a good deal of swelling under the throat extending down the neck ; and the swollen part will at first be hot and tender to the touch, but as the disease progresses it becomes insensitive and cold.

5. Although anthrax is, as already indicated, a communicable disease, it is doubtful whether it is often transmitted from the living diseased animal to the healthy by association, as in the case of cattle plague, foot and mouth disease, or other animal diseases of a contagious nature; experience goes to show that it is usually transmitted to the healthy animal through the medium of food or water containing the spores of the disease. These spores may also find their way into the circulation through a cut or abrasion. The disease may be introduced through the spreading of infected manure on the pastures, and occasionally outbreaks have been traced to the distribution of manure containing the cuttings or scrapings of hides removed from diseased animals.

6. For the reason above given it is evident that, in their own interest, it would be better for owners of stock to allow their animals when affected with anthrax to die, rather than slaughter them and thus incur a serious risk not only of infecting their sheds, stock-yards, and other parts of their farms and premises, but also of causing the death of those persons who may be engaged in slaughtering them.

7. It will be gathered from the preceding remarks that, since the means by which anthrax may be spread are somewhat different from those in the case of other contagious diseases

of stock, the measures to be adopted for preventing its extension should also be dissimilar.

8. Whenever an animal dies suddenly from some unaccountable cause, the fact should be at once reported to the Local Authority, and in the meantime the owner should forthwith plug the nostrils and all the natural openings with hay or tow saturated with a strong solution of carbolic acid, in order to prevent the oozing of any blood therefrom. The Veterinary Inspector should forthwith inquire into the cause of death, and determine by careful investigation whether anthrax exists or not. This can be done by examining with a microscope a few drops of blood taken from one of the superficial veins soon after the death of the animal.

9. So soon as it has been decided that the disease is anthrax, the owner should cause all the cattle, sheep or swine which have been in association with the dead animal, pronounced by the Veterinary Inspector to be apparently healthy, to be moved from the shed or field or other place where the disease has originated, to some other place on the farm or premises, where they can be isolated and kept under observation. The isolated animals should be given an entire change of food and water, and as the period of incubation of anthrax is usually very short, seven days will as a rule suffice to enable the Veterinary Inspector to determine whether any other animals have become infected or not.

10. The carcase of every animal which has died of anthrax should be buried in some part of the farm remote from any watercourse, and to which animals cannot or do not ordinarily have access, such as a wood or enclosure. The burial and disinfection of the carcase should be carried out under the supervision of an inspector of the Local Authority.

11. The inspector of the Local Authority should carry out or supervise a rigid system of disinfection of the place or premises where the diseased animal has been detained or has died ; also of all manure and broken fodder remaining therein.

12. There is no doubt that one cause of the periodic recurrence and persistence of anthrax on many farms in this country has been due to the skinning of the carcases of animals which have died of that disease and to the neglect of proper precautions for their burial and disinfection. The most effectual manner of destroying the germs of anthrax is by burning the carcase, or destroying it with chemical agents, and where facilities exist for carrying out either of these methods a licence of the Board must be previously obtained.

In cases where burial is adopted every facility should be afforded by the owner to the inspector of the Local Authority in order that this duty may be effectually carried out.

13. It has been found by experience that where all the above-named precautions have been scrupulously adhered to, the disease frequently ceases after the death of one animal on the farm.

4, Whitehall Place, London, S.W.,
September, 1893.

Revised, February, 1905.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Swine-Fever.

1. The Board of Agriculture desire to call the attention of Farmers and Pig-owners to the fact that the operations now being carried on against swine-fever cannot be expected to prove successful unless all connected with the trade in pigs are prepared to give active and vigorous assistance in checking the spread of the disease.

2. It should be clearly understood that swine-fever is never spontaneous in its origin. Its sole cause is the introduction into the animal system of a healthy pig of the poison from the body of a diseased pig, or from its excreta.

3. There is reason to believe that the disease is not infrequently conveyed to places at which swine are kept by means of persons who have been in contact with diseased animals elsewhere. Pig-owners should therefore prevent strangers from approaching their pigs, and if the admission of spayers or castrators be necessary, those persons should be required, before approaching the animals, to wash their hands thoroughly with soap and water, and to wash and disinfect their boots with a solution of carbolic acid and water or some other suitable disinfectant. Such persons might also with advantage be required to wear, while operating, a waterproof apron, which should be washed and disinfected before the wearer is permitted to approach the animals to be operated on.

4. The cleanliness of the sties, and the feeding of swine on suitable food, are very desirable with a view of keeping them in a healthy condition, and of giving them power to resist infection.

5. Carts, crates, nets, ropes, &c., used in connexion with the conveyance of swine, should be scrupulously cleansed

and disinfected immediately after use by thoroughly washing them with water and coating them with limewash or with carbolic acid and water, one part of carbolic acid being used to twenty parts of water.

6. Purchasers of swine should invariably keep newly-acquired animals separate from the home herd for at least a fortnight.

7. Owners are urged to refrain from moving any swine from off their premises unless they are satisfied that the whole of their stock are free from disease.

8. Under Section 4 of the Diseases of Animals Act, 1894, every person having in his possession or under his charge a pig affected with swine-fever must keep that animal separate from others which are not so affected. This provision of the Act should as far as possible be carried out directly the presence of swine-fever is suspected, and pigs so separated should be attended by special persons, who should not under any circumstances be allowed to come in contact with other pigs on these premises, or elsewhere.

9. The Board would also call attention to the importance of the prompt notification of the appearance of any symptoms of swine-fever, where the owner has any reasonable grounds for suspecting that the disease exists. Every person having in his possession or under his charge a pig affected with or suspected of swine-fever is required by law to give notice of the fact with all practicable speed to a police-constable, and there can be no doubt that the success of the measures taken to prevent the spread of the disease will greatly depend upon the promptitude with which this requirement is carried out.

10. The Board are only empowered to pay compensation for swine slaughtered by their instructions, and slaughter is ordered in the interests of the public alone in cases in which it is considered by the Board to be necessary in order to prevent the spread of disease. Compensation is never paid merely with a view to indemnify a pig owner for the losses sustained by him by reason of the outbreak of disease amongst his swine.

11. Although swine may not be moved alive from an infected place, there is nothing in any Order of the Board to interfere with the discretion of the owner in himself

slaughtering his swine for the purpose of sale or otherwise. The carcases can be removed from the premises with the written permission of an Inspector of the Local Authority.

4, Whitehall Place, London, S.W.,
January, 1896.

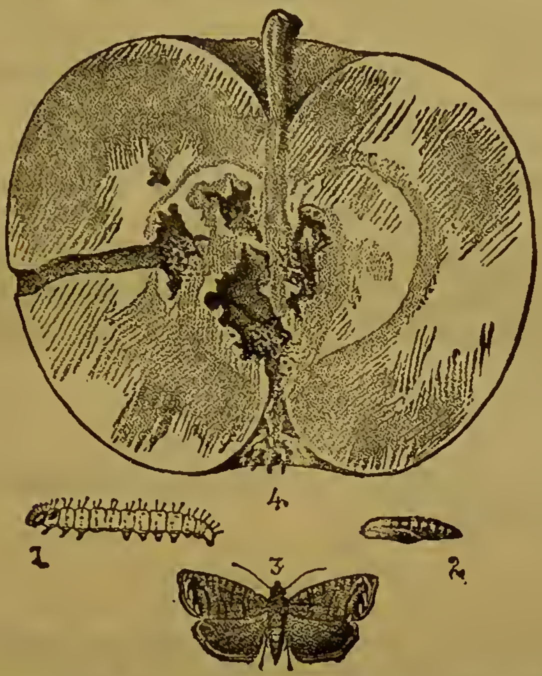
Revised, October, 1901.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 30.

BOARD OF AGRICULTURE AND FISHERIES.

The Codling Moth (*Carpocapsa pomonella, L.*).



1, Caterpillar; 2, Pupa; 3, Moth. All natural size.
4, Section of Apple showing work of Caterpillar.

This is a very small moth, but its caterpillars are, in most seasons, exceedingly destructive to the apple crop. They bore into the fruit and cause it either to drop prematurely or to decay rapidly when it is stored. Sometimes apples attacked by this insect drop off as early as the end of June, and continue to drop throughout the summer. Upon examining apples that have dropped, or those that show signs of decay in the apple-house or store, it will generally be seen that there is a dark spot at the blossom end of the apple; a small hole can also be detected here, round which there is a collection of excreta and minute morsels of apple. If such apples are split in half, a passage will be seen leading to the core, around which there is usually a mass of refuse ("frass"); and it will as a rule be discovered that the seeds, or parts of them, have been eaten. If the caterpillar is still in the apple, it will be found near the seeds, which appear to be the objects of its attack. If the caterpillar has forsaken the apple, a hole will be found on the side or some other part of the fruit, through which it has escaped.

Though this is called the "Codling moth," it by no means confines its attacks to Codlings, but was probably thus named because Codlings and some of their varieties, the Keswick Codling, for instance, are somewhat early, and, being large apples, make a great show on the ground when they fall. Varieties of apples having deep, open "eyes," and large dried tufts of the calyces surrounding them, like the Codling, the King Pippin, the Blenheim Orange, Margil, and Cox's Orange Pippin, are more liable to be infested than varieties like the

Golden Knob, Russet, Nonpareil, and others, the "eyes" of which are more closed up. This insect also attacks pears, sometimes rather severely.

This attack is not always recognised as being due to insect agency. It frequently happens that an unusual fall of apples is said to be the "summer drop," attributable to want of vigour in the tree, or to the weather. No trouble is taken to examine the dropped fruit, and the caterpillars escape from it in due time and conceal themselves, in order to pupate and produce moths for another attack. When infested fruit is taken into store-rooms, the caterpillars creep out and get into chinks and crannies in the walls and floors, from which the moths come forth and fly to the nearest apple trees in the following spring.

The Codling moth is very troublesome in France, Germany, America, Canada, Australia, and Tasmania. In the last-named country it is so destructive that the Legislature has passed an Act for its repression.

Description.

The moth (Fig. 3) is not quite three-fourths of an inch across the wings, and is about the third of an inch in length of body. The fore wings are deep grey, with many wavy lines of a brown hue. At their extremities there are oval patches of a deep golden colour, by which this moth can be easily identified. Its hinder wings are darker, having a golden tinge, and a lustrous shimmer. When the moth is at rest during the day, it is an insignificant object, sitting on the trunks and branches of apple trees, or on railings, fences, and hedges, with its wings folded in the form of a roof over its body.

The egg is flat and somewhat oval in shape, more like a scale than an egg, and about the size of a small pin's head. When first laid it is pearly white but later a reddish ring shows on it.

The caterpillar is at first greyish white in colour, with a shining black head, three pairs of claw feet, four pairs of sucker feet in the middle of the body, and a pair at the end. When full grown (Fig. 1), it is nearly three-quarters of an inch long, the head being brown and the body flesh-coloured or light pink.

The pupa is yellow-brown with spines on the abdominal segments; these spines aid in pushing the pupa out of the cocoon previous to the emergence of the moth.

Life History.

The moths appear about the end of May, flying from place to place and from tree to tree in the late afternoon and evening, the females placing their eggs singly upon the apple when these are about half-an-inch in diameter. In the American literature there are records of the eggs being laid on leaves, not only in experimental breeding cages but also in the open. The number of eggs laid by one female may, perhaps, be 50. After a week to ten days or longer—according to the weather—the

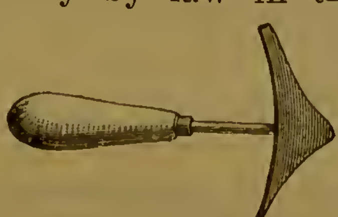
caterpillar hatches out. It enters the apple at the "eye" or calyx and tunnels to the centre to the seeds upon which it feeds, pushing back, in its progress, morsels of core, pulp and excrement, to the outside. Occasionally the caterpillar enters at other parts of the apple, *e.g.*, at the side and, it may even be, at the stalk end; entrance may be made also where two apples touch. From about three weeks to a month may be reckoned as the average duration of the active larval stage.

After the caterpillar is full grown, and has eaten the greater part of the seeds and the flesh round the core, it bores a hole from the centre to the rind of the apple, through which it makes its exit. If the apple is on the ground, the caterpillar on leaving hides itself underneath any rubbish, or crawls away to a neighbouring stem. Should the apple be still upon the tree, the caterpillar crawls down the branches and stem, or lowers itself to the ground by a silken thread. Large numbers of caterpillars pass the winter on the stems, where they construct cocoons with little bits of bark knit together with silk, or composed of silk alone; they may simply get into a convenient crack or crevice in the bark, and surround themselves with a silk case, gummed over with a sticky fluid. Sometimes the larvæ conceal themselves in cracks in posts and fences, or under the bark of trees, under cover of bands on the tree or anything leaning on the tree, and even under rubbish and dead leaves, and pieces of branches and twigs near the trees. When the caterpillar is taken in the apples into the apple store, or apple house, it comes from them in due time, and hides underneath any woodwork, or in cracks in the walls or floor.

The caterpillar does not usually pupate until the first approach of spring. There is normally only one brood in a season, but in some cases there are two.

Methods of Prevention and Remedies.

I. In order to induce the caterpillars that are crawling up or down the apple trees to congregate at certain points, bands made of old oil-cake bags, well-washed manure bags or hay ropes, should be tied tightly round the stems close to the ground early in July. To make these fit closely to the trees, and also to remove the temptation for the caterpillar to conceal itself before it reaches the band, all rough bark must be scraped off by means of a suitable implement. This banding is practised to a large extent in America, Canada, and Tasmania. It is made compulsory by law in the last-named country,



Bark Scraper.

as well as in California, that apple trees should be banded in this way in early summer. These traps must be examined

at frequent intervals in summer and autumn, and the caterpillars in the folds of the bands destroyed.

II. "Windfalls" or "drops" must be cleared away as soon as possible, and should be disposed of at once: if not fit for sale, they should be given to pigs. In orchards, sheep, pigs, and poultry are useful, as they generally eat the "drops" and maggots as fast as they fall. Where cider is made, the ground where apples have lain in heaps should be well gas-limed and dug deeply, and all rubbish near burned. The walls of apple-rooms and stores where the apples have appeared to be infested should be well swept and lime-washed in early spring. The floors, also, and shelves should be well scrubbed with soft soap, and fine netting fixed over windows and ventilators to prevent the moths from escaping.

III. Spraying the trees with caustic alkali wash in winter does much good, by removing the rough bark, &c., beneath which the larvæ are hibernating.

IV. Spraying with Arsenical sprays so that the young caterpillars may be poisoned before they gain entrance to the fruit. There are two sprays which can be used for this purpose:—Paris Green and Arsenate of Lead. The trees should be sprayed directly the blossom has fallen, not later than a week. This is because the calyx or eye remains open for that time and the fruitlets are upright in position; the arsenic thus lodges in the eye, and when the calyx lobes close over they keep the poison in position. Spraying after the eye is closed is of doubtful benefit.

For the *Paris Green spray* use 1 lb. of Paris Green, 1 to 2 lbs. of freshly slaked lime and 200 gallons of water.

The *Arsenate of Lead spray* is made as follows:—Dissolve 1 ounce of arsenate of soda in a little water, dissolve 3 ounces of acetate of lead also in water. Pour these two into 10 gallons of soft water: 1 lb. of treacle added helps to make the liquid stick.

V. The blue and other tits, as also poultry, do much good in orchards by devouring the larvæ.

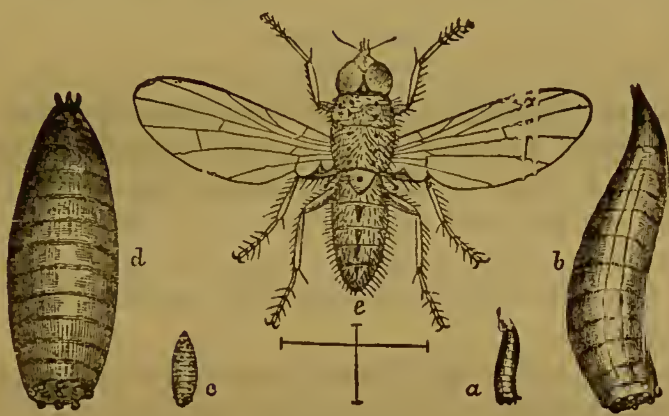
VI. All rubbish and dead wood should be cleared away from apple trees. It is most desirable that all barrels that have brought apples from abroad should be burned, especially those consigned to country towns, as many of these have caterpillars or pupæ in their cracks, which produce moths. This would help to prevent the constant fresh importations of this pest into the country.

4, Whitehall Place, London, S.W.,
June, 1896.
Revised, September, 1905.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

The Onion Fly (*Phorbia cepetorum*).



a and *b*, Larva, natural size and magnified ; *c* and *d*, Pupa, natural size and magnified ; *e*, Fly magnified ; lines showing wing expanse and length of body.

The Onion Fly causes serious injuries to the onion crop in some seasons, and it appears to be on the increase in this country. It is also a source of great trouble to the onion growers in the United States, and in continental countries. Frequently in English market gardens, and market garden farms where onions are extensively cultivated, large percentages of the plants are quite spoiled by the attacks of this fly. In cottage gardens and allotments the whole of the plants on the small onion beds of the cultivators are often ruined by successive generations of this insect.

Appearance of infested Plants.

The first indications of the infestation are shown by the longest or first leaves of the onion plants becoming yellow, and afterwards whitish; if these are pulled they come easily away from the stem, and gradually the other leaves become yellow and decay. The bulb will be found to be small and badly shaped, with dirty white maggots within its folds, feeding upon it, and eventually causing it to become rotten and useless.

In other cases the outer, or lower leaves of the plants are seen to be lying on the ground, still green ; while the leaves remaining upright and green feel soft and flabby.

Attacked bulbs decay, become slimy, and give off an offensive odour.

If infested plants are examined it will generally be noticed that in the case of very young plants they are nearly eaten through, just above the swelling bulbs, by the maggots

of the fly. In older plants with large bulbs maggots of all ages and sizes will be found within the bulbs.

Onion plants that become yellow and show signs of drooping should be examined for maggots just below the surface of the ground, the bulbs, if necessary, being cut open and examined.

Description.

The male and female flies of this species differ slightly. The male is dark grey in colour, with black bristles. The eyes are red and close together. Upon the thorax are four bright brown stripes and four rows of black bristles. The abdomen is ash-coloured, rather narrow, having triangular black spots down it which almost join each other. The legs are pitchy black.

In colour the female fly closely resembles the male, but the abdomen is dark grey, with the end more pointed than in the male ; the eyes too are wider apart.

Eggs.—The eggs are white, long, and somewhat oval, and can be easily seen without a glass.

Maggot.—The maggot measures when grown nearly four lines (one-third of an inch) in length, and is of a dull dirty white colour. The head end of its body is sharply pointed, and the head, which is furnished with a pair of black hooks, can be extended at will ; the tail end is blunt, being cut off obliquely, and in the centre there are two brown spiracles or breathing pores ; round the margin of the flat tail end there are eight prominences.

Pupa.—The puparium or pupa case is chestnut-brown in colour, oval in shape, not so long as the maggot, and has the same tooth-like projections on the caudal end. On opening this puparium the white pupa may be seen with the wings of the future fly showing.

Life History.

In April and May commonly the flies proceed to lay their eggs. From six to eight eggs are laid on an onion plant, upon the neck of the onion, and sometimes even on the lower parts of the leaves, generally just above the ground. Maggots hatch from the eggs in from five to seven days, according to the temperature and other conditions, and burrow down between the sheathing leaves into the bulb. They feed upon the contents of the cylindrical swelling, which can hardly at this stage be styled a bulb, and move on to other plants. Later, when the bulbs are larger, they are occupied by many maggots which feed within them and cause them to become rotten. The earth round the bulbs is also infested. The insect continues in the larval stage for

13 to 15 days, feeding throughout upon the onion bulbs. The full fed maggot becomes a pupa inside the brown case, generally in the soil, but sometimes in the rotten bulb, and the fly appears in from 10 to 20 days in the summer brood.

There are several generations of this insect in the year. The first has been seen as early as the 25th of April in very forward seasons, and flies have been noticed through the autumn, and as late as November. Curtis states that he saw them alive in December. Maggots may often be found early in May. The winter is passed in the puparium stage in the soil of the onion beds, or it may be in the harvested onions which soon decay in the store-room.

Methods of Prevention and Remedies.

1. Spraying onion plants with offensive compositions is a good way of preventing infestation. Paraffin emulsion is as good a compound as any for this purpose. It may be made by thoroughly mixing together 3 pints of paraffin and ½ lb. of soft soap with one gallon of boiling water. Mixing may be done by passing the composition through a hand pump once or twice; six gallons of water should be added to dilute it sufficiently, so as not to burn the onion leaves. When the onion leaves are young and very tender 7 or 8 gallons should be added. It may be applied on small plots of onions with a knapsack machine ; on large breadths with a horse distributing machine. The spray should be dense and in the form of mist. This operation should be performed early in the season, when the onion plants are quite small.

Spraying should be repeated probably twice or thrice, especially if heavy showers fall after the process.

2. Another preventive measure is to mix sand with a little paraffin and place it at the base of the onion plants or work it into the soil.

3. Sprinkling the onions with soot may be adopted with advantage, where onions are sown broadcast.

4. Kainit, broadcasted on land cropped with onions, at the rate of 5 cwt. per acre, has also been found to be of great use. The action of kainit, as a preventive of some kinds of insect attack in larval form, has been often noticed, though it is rather difficult to define the form or nature of its action. It is not the stimulus that it gives to plants which makes them grow away from their enemies, as kainit is not by any means a forcing manure. Kainit should be finely powdered and hoed in very lightly after it has been broadcasted on the land.

5. Where the seed is sown in drills or shallow trenches egg-laying may be prevented by earthing-up the onion plants well over the neck.

6. When onion plants in a field or garden are noticed to droop and wither, all such plants should be taken up and burned, or placed in quick-lime. They may be taken up by means of the little three-pronged fork used in market gardens, or some other handy tool, so that every particle of bulb and leaf is removed.

7. A mixture of lime and soot, in the proportion of 1 bushel of soot to 2 bushels of lime, is useful. It should be very finely powdered and broadcasted over the infested plants, and lightly hoed in.

8. Nitrate of soda, applied at the rate of 1½ to 2 cwt. per acre, should be put on infested land in order to stimulate the plants and make them grow away from the enemy.

9. Wherever it is possible, onions should not be grown again, for at least one season, on land where this crop has been infested, as the puparia remain in the ground during the winter. All pieces of bulbs should be got off infested land, as the larvæ occasionally pupate in the bulbs. If it is necessary to take two successive crops of onions on infested land the ground should be dug very deeply, two spits deep and well limed, or gas-limed.

4, Whitehall Place, S.W.,
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BOARD OF AGRICULTURE AND FISHERIES.

Foul Brood or Bee Pest.

Description.

Foul brood or Bee pest is the most terrible scourge of apiculture. It spreads so rapidly by contagion in a single season, that, unless precautions are taken, a whole neighbourhood may become affected, and the chances of successful bee-keeping therein will be seriously imperilled, if not utterly destroyed.

Foul brood is caused by a rod-shaped micro-organism, called *Bacillus alvei*, which increases by cross-division, and has, under certain conditions, the power of forming spores. It is important to note that bacilli are present in the earlier stages of the disease, but in the later stages, when the brood has become rotten and coffee-coloured, or has dried up to a scale, the bacilli produce spores and then perish. These spores represent the seeds of the evil, and retain the power of germinating into bacilli when in contact with a suitable nourishing medium at a proper temperature, even after the lapse of long periods.

The spores are endowed with wonderful vitality. Freezing, carbolic acid, thymol, salicylic acid, beta naphthol, perchloride of mercury, as well as creolin, lysol, eucalyptus and naphthaline, which evaporate at the ordinary temperature of the hive, prevent the growth of the bacilli, but have much less action on the spores. From this it will be seen how great is the difficulty in curing foul brood unless the disease is attacked in its earliest conditions.

Symptoms.

When stocks are found weak, working languidly, very slightly profitable, and swarming little, foul brood may be suspected. If it is present, an examination of the combs will show some cells (many or few) containing dying or dead larvæ, and others with their covers sunken or perforated (*see illustrations*), the cells of healthy brood being usually compact, and the grubs plump and of a pearly whiteness. When healthy, the young larvæ are curled up in crescent shape at the base of the cells. On the other hand, if diseased, they are found extended horizontally in the cell, presenting a flabby appearance, and of a pale straw colour. As they begin to decompose, the colour changes to brown. They then dry up till all that remains of them is a brown scale adhering to the side of the cell. Should the larvæ survive until capping takes place, a few of the cell-covers will be found here and there slightly indented and darker in colour than those of healthy brood. The capped cells will be observed in irregular patches and mostly perforated. On removing the capping, the contents will be seen to consist of a putrid, sticky, elastic, coffee-coloured mass.

formed of the rotting larvæ. The bees do not seem to have the power to clean out the foul cells which consequently spread infection within the hive. The stock becomes too weak to defend its stores, some neighbouring colony then probably steals the honey, and in doing so carries away the seeds of disease and death, which are thus spread, until all the hives of a neighbourhood may be fatally affected.

Hives in which foul brood exists emit a sickly and unpleasant smell, and when the disease is of a malignant type and in a very advanced stage, the foul odour may frequently be detected at a considerable distance.

[*From a photograph lent by the Department of Agriculture and Technical Instruction for Ireland.*]

Fig. 1. Portion of a comb affected by foul brood in an advanced stage. The empty cells are those from which healthy brood has been produced, or which have been occupied by diseased larvæ, the remains of which are not discernible in the print. All the capped cells bear the appearance of being diseased. This is indicated by the sunken cappings of the cells, and the numerous perforations in the cappings.

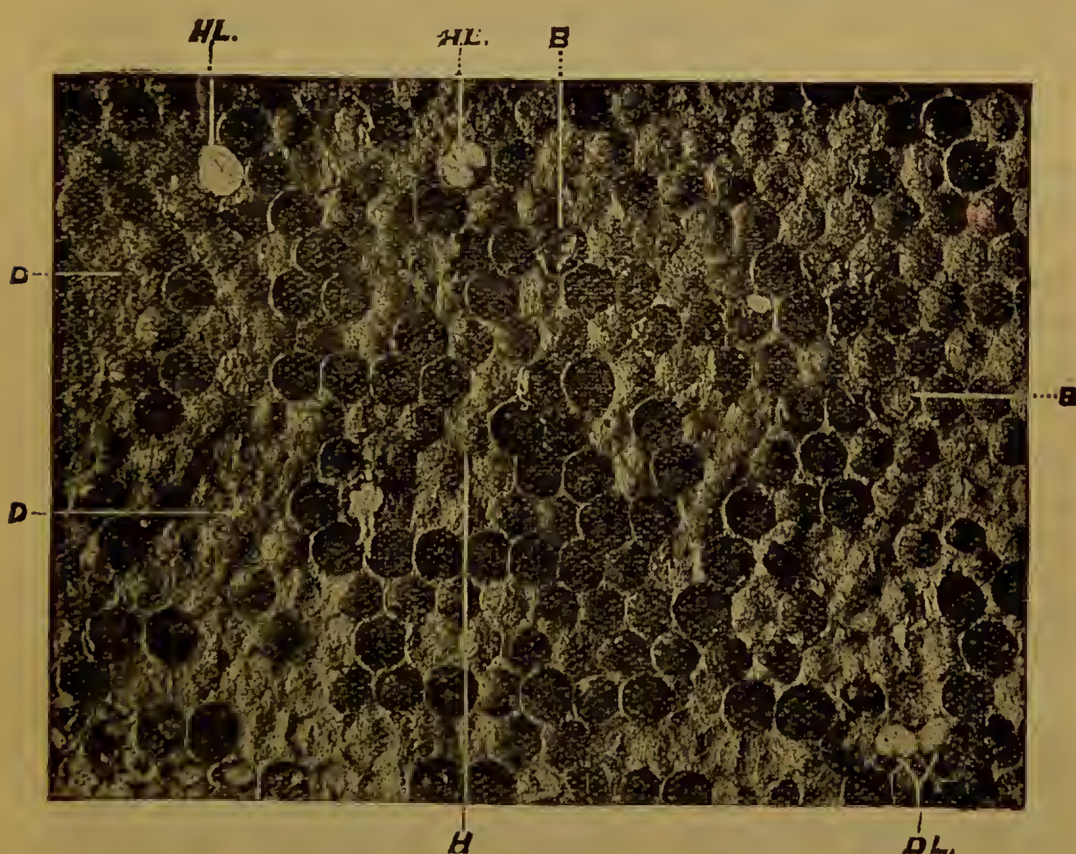
It should be noted that "chilled brood" must not be mistaken, as it very frequently is, for foul brood. The dead larvæ of "chilled brood" turn first grey, and afterwards become nearly black (never brown, as with foul brood). They are also generally removed by the bees, which seldom attempt to carry away larvæ which have died from disease, unless disinfectants to arrest decomposition are used.

Sources of Infection.

Experience has plainly shown that with foul brood—as in all epidemic diseases—the weak, sickly, and badly nourished

are specially liable to attack, and become centres of infection the disease being spread in the manner described above.

Another very important point is that the bee-keeper may himself be the means of spreading the pest by indiscriminately manipulating, first diseased, and then healthy hives, without taking proper precautions to disinfect himself and his appliances. Combs which have contained foul brood retain the spores. The queen lays eggs in the cells and the workers deposit their honey and pollen in them. The



[*From a photograph lent by the Department of Agriculture and Technical Instruction for Ireland.*]

Fig. 2. Portion of comb affected by foul brood, in a less advanced stage than *Fig.* 1. The raised cappings indicate that there is a good deal of healthy brood, but the presence of diseased brood all over the comb is indicated by the sunken cappings.

H. A group of healthy cells; other healthy cells being observable all over the comb.

D. Two groups of diseased cells, of which there are many more.

B. Healthy bees emerging from their cells.

H.L. Healthy larvæ.

D.L. Diseased larvæ. Note that these larvæ are not lying like the healthy larvæ.

honey and pollen in this way become vehicles for the transport of the disease to the larvæ in the process of feeding by the nurse bees. Under no consideration should infected hives or combs be exposed to the visits of bees. Carelessness in this respect may work immense mischief to neighbouring stocks and apiaries.

Prevention and Remedies.

In endeavouring to get rid of foul brood, efforts must be made to raise to a high standard the lowered vitality of the bees, which first enables the germs of the disease to develop. Strong stocks only, with young and prolific queens should be kept, and good wholesome food, cleanliness, proper ventilation, and freedom from dampness are also important.

When the bee-keeper has been in contact with diseased stocks, his clothes, appliances, and hands must be washed with carbolic soap, and other articles disinfected by spraying with a solution of one ounce Calvert's No. 5 carbolic acid in 12 ounces of water.

It was formerly thought that honey was the only source of infection, so that, if bees were starved until they had got rid of the honey carried by them from the diseased hive, a cure would be effected. It is now known that the starvation method always fails when it is not supplemented by disinfection of hives, etc.

When the disease is discovered in a weak colony, the destruction of bees, combs, frames, and quilts, together with a thorough disinfection of the hive, is by far the best course to pursue. The spores are destroyed, and the source of infection removed.

If the colony be still strong, the bees may be preserved by making an artificial swarm which should then be placed in a straw skep and fed on syrup to which three grains of naphthol beta have been added to every pound of sugar used, the naphthol beta being dissolved in alcohol and added to the syrup while still warm. Medicated syrup is unnecessary where the ventilation is perfect.

The infected frames, combs, and quilts should then be burned, and the hive roasted, cleaned, and well painted. When the smell of the paint has disappeared, the hive will be ready for use. The bees must be confined to the skep for 48 hours, by which time all the honey they may have taken with them will have been consumed, and such of the bees as are diseased will have died.

It may be added that in attempting remedial measures of the nature described, it would be desirable, wherever such help can be procured, to seek the advice of an expert.

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BOARD OF AGRICULTURE AND FISHERIES.

Surface Caterpillars.

1.

2.

1. Caterpillar of the Turnip Moth (*Agrotis segetum*).

2. Caterpillar of the Heart and Dart Moth (*Agrotis exclamationis*).

Plants attacked.

These caterpillars cause serious injury to many crops of the farm, market-garden, and garden, and particularly to mangolds, turnips, swedes, and potatoes. They, in common with caterpillars of other species—notably that of the Great Yellow Underwing moth—are styled "surface caterpillars," because they hide beneath the surface of the soil, and usually attack most kinds of plants at, or just below, the surface, and nearly always in the night-time. The "cutworms" in the United States are similar creatures, and are so called because they cut the stems of plants asunder. Some of these American "cutworms" belong to this same genus of *Agrotis*.

Young mangold plants, and mangold plants whose growth is retarded by drought, are frequently cut through by these caterpillars below the surface of the earth, and potatoes are also attacked, the caterpillars eating into the tubers, particularly where earthing-up has not been well done. Turnips, swedes, and mangolds are often spoilt by these caterpillars, which completely clear out the insides of the roots, or so injure them that they become rotten.

Wheat and other corn plants suffer seriously from *Agrotis* caterpillars, especially wheat in mild winters. This injury is often attributed to wireworms. Grasses in pastures, particularly those with thick bulbous stems, are often eaten by

these caterpillars, which do more injury to grass land than is generally imagined. Reports have also been received of damage to the cabbage, lettuce, and carrot, to garden plants, and to flowers and seedling trees. The caterpillars pass the winter in the ground in the caterpillar state, and are adversely affected by frequently alternating frost and thaw. Mild dry springs are favourable to these pests. Dry weather prevents the caterpillar disease, which is always more prevalent in rainy seasons.

Description and Life History.

Agrotis segetum.—The male moth, rather smaller than the female and lighter in general colour, has pale grey or grey-brown forewings; its hind wings are pearly white. The antennæ are combed.

The female measures about 1½ inches in spread of wings; its forewings are dark brown; the light hind wings are clouded at their posterior margin. The antennæ are plain and threadlike.

Agrotis exclamationis.—Male paler than the female; forewings light brown, hind wings white. The antennæ are slightly dentate, or toothed.

Female red-brown in colour, the forewings dark brown, and the hind wings also brownish. The antennæ are plain and threadlike. The wing expanse is about 1½ inches and the length of the body about three-quarters of an inch.

Caterpillars.—The full-grown caterpillars are nearly 1½ inches long. One species can be distinguished from the other only by careful inspection. Close observers will note that the *Agrotis exclamationis* caterpillars (No. 2) are darker than those of *Agrotis segetum* (No. 1), the former being brownish, while the latter are grey. The most important distinction, as pointed out in Buckler's British Moths, is that in *Agrotis exclamationis* the quite black spiracles are always larger than the spots before and behind them, and that upon each of, at least, the first five segments, there is a pear-shaped blotch, rather darker than the body colour.

Life History.—The habits are the same in both species. Eggs like poppy seeds are laid at the beginning of the summer, and fastened near the ground to the leaves of cultivated plants, and of plantain, goosefoot, chickweed, and many cruciferous weeds. Caterpillars come from these in from 10 to 12 days, and begin to feed at once.

These caterpillars feed from their first appearance in summer to the spring of the next year, though probably a few of them, as stated by Mr. Barrett in his Lepidoptera of the British Isles " appear to feed up rapidly by the middle

" of August, producing moths the same autumn, and rein-" forcing the great army of wintering larvæ." During severe frosts they retire to cells in the earth. In the spring the caterpillars, being nearly full grown, feed most ravenously, finally changing, about April and May, into reddish-brown pupæ, in earthen chambers, in which state they remain for about a month.

Methods of Prevention, and Remedies.

(1.) To prevent a recurrence of the attack it is desirable to lime infested fields with ordinary lime, or gas-lime finely powdered, and to plough deeply. Turnips and swedes that are infested should be fed off early by sheep. Land after roots where there has been infestation, should be limed, ploughed deeply in autumn, again ploughed, but shallow, in spring, and not sown till March or April. It would be dangerous to sow wheat immediately after a badly infested crop of potatoes, turnips, swedes, or mangolds.

(2.) Weeds must be kept down in fields and gardens, especially cruciferous weeds, such as charlock, which afford shelter for the eggs and food for the young caterpillars.

(3.) The frequent stirring, with horse and hand hoes, of land having crops in drills, such as turnips, swedes, and mangolds, disturbs the caterpillars and kills some of them. Caterpillars or pupæ escaping death by crushing are exposed to such birds as rooks, gulls, starlings, and lapwings. The harrowing of young wheat is also of considerable advantage.

(4.) Fresh, pure, finely-powdered soot scattered on both sides of infested plants and lightly chopped in has proved to be of considerable benefit. It keeps the caterpillars off, at all events for a time, and gives the plants a chance to grow away, at least in ordinary seasons. In seasons of extreme drought this application should be repeated.

(5.) Lime mixed with soot in the proportion of 3 or 4 bushels of very finely powdered lime to 1 bushel of soot, forms a pungent compound found to be very useful in similar caterpillar-attacks, and should be sprinkled close to infested plants. The beneficial influence of soot and lime is probably due as much to its stimulating growth as to any direct effect on the larvæ.

(6.) Kainit, put on in a similar manner, near to infested plants, has a marked effect upon the caterpillars under certain climatic conditions. It is desirable to force the plants on with small repeated dressings of artificial manures, such as guano and nitrate of soda.

(7.) Potatoes should be well "earthed" where there is any fear of infestation, and the earthing should be done early in the season.

(8.) In market-gardens and gardens, and in the case of valuable crops, as cabbages, lettuces, celery, radishes, carrots, and herbs, hand-picking is advocated. The workers, provided with a lantern, and armed with a blunt knife or a pointed piece of wood, make a round of the plants at night, and dig up and collect the caterpillars. On a small scale this measure, though tedious, may be very effective.

(9.) In America there are numerous records of successful treatment by poisoning the caterpillars. This may be done by spraying clover or grass or other plants with Paris Green (1 lb. Paris Green to 50 gallons of water, the mixture to be kept well stirred) afterwards tying these sprayed plants into bundles and distributing them at intervals amongst the crop.

The caterpillars eat the material so treated and are poisoned by the Paris Green. It must be remembered that Paris Green is a dangerous poison; those using it must not inhale it or allow it to get into cuts in the hands, and neither grazing animals nor poultry should have access to fields where the Paris Green treatment is being practised.

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BOARD OF AGRICULTURE AND FISHERIES.

The Woolly Aphis, or Apple Root Louse.

(*Schizoneura lanigera.*)

1. Winged female, magnified ; and line showing natural size. 2. Wingless viviparous female, magnified.* 3. Apple twig, covered by woolly aphides.

Distribution.

This insect is always more or less abundant in old and neglected orchards and apple plantations where the trees are unpruned and are covered with moss, lichens, &c. But unfortunately this pest is only too frequently to be seen even

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* Figure 2 is reproduced, with permission, from Mr. G. B. Buckton's "British Aphides."

in orchards recently planted. Nursery stock is frequently sent out with families of the Woolly Aphis on the trees. It is especially on such young material that these plant-lice do so much damage. The bark is pierced by the mouth parts of the aphides, which obtain their nourishment entirely from the sap. Like all plant-lice the Woolly Aphis feeds during all phases of its life, as ravenously in the pupal and adult, as in the larval or "louse" stage.

The Woolly Aphis may readily be recognized in an orchard by the masses of white woolly substance formed by the larvæ and females which are sheltering in the crevices of the bark. The white woolly substance is formed as an excretion from glands in the backs of both the young and mature females. It may often be seen hanging in festoons from the trees. These masses of "wool" get blown off and are carried by the wind, often for some little distance, and with them are carried the young *Schizoneuræ*. On examining the white wool there will be found little groups of plant-lice in various stages. Dispersal by the agency of the wind is by no means unimportant, but by far the most common way in which this pest is distributed is in infested nursery stock. Not only has it been carried from orchard to orchard in our country in this way, but from country to country, until it is now found in every part of the world where apples are grown.

Description and Life-History.

The Woolly Aphis belongs to the genus *Schizoneura*. The arrangement of the nerves on the wings is made use of in Aphides for distinguishing different groups. The chief vein of the fore-wings gives off three branches; the branch furthest away from the insertion of the wing forks into two in *Schizoneura*, and this distinguishes *Schizoneura* from another Aphis that infests the apple, viz., *Aphis pomi* (*mali*), where one of the two branches forks again, near its apex. Again, while *Aphis pomi* (*mali*) has projecting from its back two tubes known as cornicles or honey tubes these are absent in *Schizoneura*. The wingless females are oval, of a purplish-brown hue, quite devoid of honey tubes, and have numerous white threads passing out of their backs. Their antennæ and legs are very short and dark reddish-brown to black. They, like other Aphides, produce live young in great numbers. These young forms are of a dull yellowish to reddish colour, and when adult may be concealed under a covering of long spiral whitish threads, which have issued from pores. Occasionally in the summer winged females occur; the winged female is dark chocolate brown in colour, and is provided with two pairs of transparent wings with brown veins. The winged females are never very common, but appear now and then in Great Britain from July to September. Towards the end of the

year a few wingless females and males are produced, the former depositing a single egg in the crevices of the bark. Neither the egg-laying female nor the male has any piercing proboscis. The egg-producing female is reddish-yellow in colour and very small, seldom exceeding ·003 of an inch. When she has laid her single egg she dies, and her skin forms a case over it and to some extent protects it.

These few eggs remain on the tree all the winter, and when they hatch give rise to the Queen Aphis or Stem Mother, the wingless viviparous female that, in turn, gives rise to the new generations of the year. Or the continuity of the species may be carried out by the hibernating females, which, sheltering in crevices in the bark, and beneath moss and lichens, are not affected by frost. They have been seen active when the temperature was much below freezing point.

Injury caused.

Not only apples but pears also are sometimes affected. All varieties in this country are subject to the ravages of the pest, but perhaps the old Ribston Pippin suffers most of all. The Blenheim Orange, Cox's Orange Pippin, and Lord Suffield also suffer severely. It is especially those trees with a soft rind that are most affected. Certain experiments conducted in Victoria tend to show that apples grafted on Majetin and Northern Spy stocks are immune against this pest.

The term "American Blight" is often applied to the Woolly Aphis; it should not be used, however, as the pest was originally European, and is now found wherever apples are grown.

Not only are the boughs, trunk, and twigs attacked, but also the roots. In parts of North America the damage done to apple trees by the subterranean form of Woolly Aphis is very great. This method of living also occurs in Great Britain.

In America the subterranean form is called the Apple Root Louse. The two forms are the same species, and Professor Stedman, of Missouri, has shown that the two forms can migrate, from the trunk to the root, or *vice versâ.*

The Woolly Aphis injures the trees by causing swellings and excrescences upon them, and by drawing away the sap. The irritation caused by their beaks in the tender tissue of the shoots causes an abnormal growth of cells, which ends in the large "canker-like" patches in which the blight more or less shelters. Similar growths are formed on the roots. These rugosities are often taken for true "canker," but on examination the presence or absence of white wool will at once decide the question.

Certain other ground Aphides produce white wool, and must not be mistaken for the ground form of *S. lanigera.*

Natural Enemies.

There are not many natural enemies that do much good in checking the increase of this pest. Possibly the woolly excretions and oily globules that surround the insect keep off the various foes which attack unprotected plant-lice.

The larvæ of Lady-birds (*Coccinellidæ*) devour them, as also do the adult Lady-birds. Larvæ of several species of Hover Flies (*Syrphidæ*) also feed upon them, but not to the same extent as upon other plant-lice. Lace Wing Flies and Ichneumon Flies are seldom found attacking them. Small dipterous larvæ of the genus *Pipiza* feed on the subterranean form. Perhaps the Tits (*Paridæ*) do most good in keeping down this pest. These little birds, especially the Blue Tit, do inestimable good by devouring Woolly Aphis and other pests all the year round, and should be protected in every orchard.

Methods of Prevention and Remedies.

(1.) This blight is especially prevalent in neglected orchards, where the trees are set close together, and have their trunks and boughs covered with lichens and moss, and where rank grasses grow below. These points should all receive attention and be remedied at once. The vegetal encumbrances can be removed by washing the orchards during winter with caustic alkali wash. This wash is composed of 10 lbs. of caustic soda, 10 lbs. of carbonate of potash, and 100 gallons of water, to which two or three pounds of soft soap are added to make the wash stick more readily to the trees. This is by far the best way of cleaning the trees, and at the same time it destroys many hibernating insects.

(2.) Another plan likely to do good is to whitewash the trunks of the trees. Before this is done all the rough bark must be scraped off, so that a smooth surface is made to take the wash. The best "paint" to use is one made of soft soap and lime, as follows :—1 lb. of soft soap, 1 gallon of lime, and a small quantity of size, mixed with just sufficient warm water to form a thick whitewash.

(3.) In destroying this insect during the summer and when it is on the young wood, washing to be effectual should be commenced directly the first traces of the white wool appear. Ordinary soft soap and quassia wash (See Leaflet 16) may be used, but paraffin emulsion (See Leaflet 16) has been found best for this attack.

(4.) With regard to the attack on the roots, great care should be taken to see that all young stock is clean before planting. If any traces of tho "root louse" or the aerial form

are seen, the trees should be returned to the nurseryman to be disinfected before being planted. All nursery stock should be fumigated with hydrocyanic-acid gas, and thus thoroughly cleared of all insect pests before planting.

Where the root form is committing havoc, the best plan is to use bisulphide of carbon. This is injected into the soil in four places about two feet away from the trunk of the apple tree. One fluid ounce of bisulphide of carbon is sufficient for a good sized tree, injected into the soil so as not to come into actual contact with a root.

This plan works very well and should invariably be followed when any white wool or rough lumps are seen on the roots of trees that seem to be in an unhealthy state. On exposing the roots the signs of Woolly Aphis can easily be noticed and the remedy then applied around the trees.

It must be remembered that both hydrocyanic gas and bisulphide of carbon are very poisonous ; and that the latter substance is highly inflammable, and should not be brought near a light.

(5.) Kainit hoed in round the roots has also been found efficacious in Canada.

(6.) In Australia two varieties of apples are said to be proof against the action of the Woolly Aphis by reason of their bark being hard and its tissues close, thus resisting the action of the beaks of the insects. These are the Northern Spy, an American apple, and the Majetin, a Norfolk (England) variety. Apples in Australia are now always worked upon these stocks. Mr. French, Government Entomologist of Victoria, says, "Before the advent of these excellent blight-proof stocks, the Majetin and the Northern Spy, it was exceedingly difficult to find in most orchards an apple tree that was clean or in perfect health. Now, with a little care and attention, the fruit grower, as a rule, may snap his fingers at the American Blight."

Orchardists in Great Britain might profitably pay attention to this subject, which has been overlooked here. The two varieties, Northern Spy and Majetin, do not seem to be known in this country to the majority of growers and nurserymen.

4, Whitehall Place, London, S.W.,
October, 1896.
Revised, May, 1905.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

The Celery Fly (*Acidia heraclei*).

1. Fly magnified. 2. Larva magnified. 3. Pupa, natural size.
Lines showing natural size of Fly and Larva.

Great injury is frequently caused to celery and parsnips by the larvæ of the Celery Fly (*Acidia heraclei*, formerly known as *Tephritis onopordinis*). In mild seasons they are found injuring the leaves even in winter. In one bad attack which occurred in 1895, larvæ were found in the leaves as late as the beginning of December. Parsnips are also attacked by this fly in some seasons, and the affected roots are consequently small, much forked, and generally of a bad shape.

The larvæ make mines or passages in the leaves, and feed upon the soft juicy substance. The leaf soon contracts, blister-like patches appear, at first pale and later brown, in which larvæ can be found, and after a short period it shrivels up and is utterly useless to the plant. In the case of celery plants thus infested the stalks, or stems, that have been earthed up in order that they may become blanched, cannot grow and fill out properly. Sometimes the plant is killed or the celery is small, green, and bitter in flavour.

The larva of another fly, the Celery-stem fly (*Piophila apii*), tunnels down the blanched stalks between the folds close to the somewhat bulb-like end, evidently feeding upon the sweet juice. Its passage down the stems can be distinctly traced by rusty marks, which materially injure the appearance and the flavour of the celery, and in some cases cause it to rot.

Description.

The fly (Fig. 1) first appears in April; it is only about one-eighth of an inch in length, with a wing expanse of nearly half an inch. It is tawny brown in colour, or, as Meigen terms it, "honey yellow," with the under

part of the body lighter coloured. The wings are transparent and iridescent, with oblique lines of brownish or rusty spots running through them, and the poisers are of a dark yellow hue. The eyes are deep green in colour; and the six legs are dark yellow and covered with black hairs. When the fly is at rest upon the plants its wings are folded in an upright direction. The female fly is larger than the male.

The larva is white to very light green, without legs, and the dark line of the alimentary canal is visible along the back. The body is thick, pointed at the head and squared off at the tail end, upon which there are black tubercles.

The puparium is oval, of a light yellow colour, barrel-shaped, much wrinkled, and about one-eighth of an inch long.

Life History.

The fly places its eggs singly upon the upper sides of the celery and parsnip leaves. Many eggs are laid by one female. The eggs are hatched in about six days, and the larvæ from them at once bury themselves in the leaf tissues and form mines within them. In about 14 days the larva changes to a pupa inside a pupa-case or puparium, either remaining in the leaf or falling to the ground. The fly hatches out in a few days, and there are several broods or generations in the course of the summer. The last generation remain in the puparium stage in the earth and also on pieces of leaf and stalk throughout the winter.

Methods of Prevention and Remedies.

1.—When the celery crop has been taken from the trenches the earth should be carefully levelled and well dug, and the upper surface buried deeply to prevent the flies from coming up from the puparia that are found in the soil. This should also be done in the case of infested parsnips.

2.—If infestation is severe, a number of puparia will remain in the soil. These puparia should be destroyed either by skimming the surface layers and burning, or else by a dressing of gas-lime.

3.—Directly the celery or the parsnips have been dug, every particle of foliage and stem should be collected and burned. If it is merely put in lumps or upon compost heaps, or mixens, not in active fermentation, it is most probable that the puparia will be carried out with manure for celery or parsnips, or other crops grown near, and the flies will issue in due course. In cases where the foliage and stem cannot be conveniently burned they should be deeply buried. This pest will not be stamped out unless celery and parsnip growers are most particular in destroying the remains of infested plants.

4.—Thistles also should be kept down. Curtis says that the fly infests the "Cotton Thistle," *Onopordum acanthium.* Meigen and Macquart both say that it infests thistles in France and Germany.

5.—It is desirable to force rapid leaf growth where there is a bad attack. Nitrate of soda mixed with a little agricultural salt, also frequent and heavy watering, will effect this.

6.—Finely-powdered soot or lime scattered over the plants while the dew is on them might prevent the flies from laying eggs upon the leaves. A mixture of finely-powdered soot and lime in the proportion of one bushel of lime to three bushels of soot has been found efficacious, if put on when the leaves are damp from dew or rain.

7.—Spraying the plants with various preparations has proved to be the most beneficial treatment. A mixture of paraffin and soft soap and water, at the rate of a quart of paraffin and half a pound of soft soap to 10 gallons of water, has been found very effective. The paraffin and soft soap must be thoroughly incorporated in a small quantity of hot water before being mixed with the cold water. A spray made with a pint of carbolic acid and half a pound of soft soap to 10 gallons of water has been tried also with advantage. These preparations should be sprayed lightly on the plants by means of a knapsack machine, and will prevent the flies from laying eggs upon them. It will be necessary to spray twice or more during the season. It is especially upon young plants that this treatment is so beneficial—the first generation of the flies being kept off the plants others do not appear.

4, Whitehall Place, S.W.,
March, 1897.

Revised, August, 1905.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Cultivation of Osiers.

The Board of Agriculture have extracted the following information relating to the cultivation of Osiers in the Fen districts from a report by one of their Land Division Inspectors who undertook a special inquiry into the subject in the year 1893.

The term Osier is popularly used as comprehending all the trees or shrubs of the Salix genus which are cultivated as a crop to be converted by the basket-maker and similar craftsmen into various articles which are known as wicker work. The genus Salix includes willows, sallows, and osiers. Most of the kinds grown for a crop in the Fen district are, it is stated, really willows, and not osiers.

Osiers are grown in enclosed plantations, which are locally known as holts. The produce of the osier holt is known commercially as "rods."

Green rods are fresh cut and unpeeled.

Brown rods are those which have been left to dry in their skins.

White rods are those which have had the bark removed or peeled.

Buff rods are produced by boiling brown rods and then peeling them; but the colour thus produced is imitated by dyeing.

In the Fen district osiers are chiefly grown along water-courses, on land which is subject to flooding. A variety of circumstances contribute, perhaps, to this situation being almost universally selected. It is not merely that this is the natural *habitat* of the genus, and that the soil is suitable, but the convenience of having close at hand water carriage for a bulky and heavy crop, which must be for the most part removed in a green state, has no doubt tended to restrict the growth of osiers almost entirely to the neighbourhood of rivers. An additional reason for the selection of such sites is, that the periodical winter floods bring down from the uplands a considerable quantity of soil which acts as a fertiliser. Floods, however, are occasionally the cause of considerable injury to the holts. An ice flood cuts the rods and seriously damages them. Sheet ice settling down on the holt will entirely destroy a crop, and a spring flood which covers the young shoots will kill them; but freshets, which disappear quickly and which do not rise above the tops of the rods, do no harm.

The most suitable soil for the growth of osiers is a deep, rich, moist, alluvial soil. Any good clay may be planted if

sufficiently moist. Peat, moor, and hot gravels, are absolutely unsuitable. Though water is requisite, a holt will not thrive in stagnant water.

The site of a holt having been selected, the land must be thoroughly cleaned during the summer before planting, and it may be worth while to give it a complete summer fallow. Before the winter sets in it must be thoroughly stirred either by digging or ploughing to a depth of 14 or 16 inches.

If the soil is not naturally rich, it should be manured, and soot is said to be a good preparation for the crop.

Planting should be done in February or March. The sets are cut from wood of two years' growth—they should be 16 or 18 inches long, and about 10 inches of the set should be in the ground. During the spring and early summer the spaces between the rows must be kept clean by hoeing and forking. The cleaning must be completed before the middle of June, or the osiers will be injured. The cost of cleaning is variously estimated at from 1*l.* to 2*l.* per acre per annum for the first two years. After that time the expense of cleaning is much less, as the dense and rapid growth of the osiers stifles and smothers all other vegetation. It may be mentioned in passing that the young shoots from an established stock will make a growth of 18 inches in the course of a single week.

Under the most favourable circumstances the newly-planted holt will be at maturity after a period of three years, but as a general rule four or five years must elapse before its full development.

A holt properly planted, kept clean, regularly filled up, and well managed will last from 10 to 15 years, the duration depending upon the sorts planted and upon various circumstances which affect the several kinds of osiers in different ways.

The willows and osiers usually grown in the Fen district are known locally by names indicative either of some characteristic of the tree or of the country from which it has come. The favourite sorts are :—

Glibskins.—In some situations this kind is particularly liable to "scab."

Black Mauls.—Small, but hard and tough, and consequently valuable.

Green Sucklings.—A heavy cropper, but not liked by the basket-maker.

Welsh Osier.—This has a very bitter rind, which is disagreeable to all animals ; it is planted on the outsides of holts.

Black Hollanders ; Mottled Spaniards ; Cane Osiers ; and Dutch Red.

Most of these have been botanically determined at the Royal Gardens, Kew. Cuttings of a dozen kinds were

obtained from a practical osier grower in Hunts; and it was found that *Glibskins*, *Black Mauls*, *Green Sucklings*, and *Black Hollanders* were all varieties of *Salix triandra*. The *Welsh Osier* is known botanically as *Salix purpurea*, the *Mottled Spaniard* as *S. decipiens*, and the *Cane Osier* as *S. viminalis*.—(*Kew Bulletin*, 1896, p. 143.)

A certain proportion of the coarse-growing osiers may be grown, as the basket-makers require some strong stout rods for uprights; where they are not grown their place is supplied by leaving a portion of the holt to grow for two or three years.

The osiers attain to their full growth by the middle of September. They will make an average growth of 8 or 9 feet, and, occasionally, as much as 13 feet, in a single season.

Cutting the rods commences with the new year, if the holts are accessible. Sometimes, however, floods or other circumstances prevent the early cutting, and the process has to be postponed. It is, however, considered very desirable to cut before the sap rises, as the stocks bleed, and the new growth is less vigorous, if the sap has risen before cutting. The rods are cut with a sharp hook, somewhat like a strong reaping hook; a clean cut, without splitting the rod, is essentially necessary. As the rods are cut, they are tied up by willow bands into bundles or "bunches." Each bunch has a girth of 45 inches (an English ell) at a distance of 1 foot from the butt end of the bunch. The "ell band" is secured in its place by attachment to another band, called the "breech band," round the butt end. A third band is placed higher up. An average crop will be about 150 bunches per acre, and a heavy crop will reach to 250. A green bunch will weigh 6 stones.

It has already been observed that it is a great advantage if this bulky and heavy crop can be removed by water carriage.

When the rods are to be peeled, they are conveyed to the peeling yard and placed with their butt ends in water, where they remain until the rise of sap makes the peel separate easily from the stick. Sometimes after the rods are cut they will dry from exposure to the air, and in that case they are put in a heap, watered, covered up, and sweated, or "couched" as it is called. If the rods in the pits get too advanced in growth before peeling, the difficulty of peeling is increased, and the rods are damaged. The work of peeling begins as soon as any of the rods are fit. It is chiefly done by women, who draw the rods through a "break" or "cleave." This divides the bark into strips, which are removed by the hand. The children of the peelers assist in this latter operation.

As the rods are peeled, they are sorted into three grades, "large," "Middlesboro," and "small" rods, according to

their size and length. They are then exposed to the air for a short time on racks, or reared against hedges or walls. When dry they are tied up in bunches of the same dimensions as before, and stored away in sheds.

Rods which are adapted for the purpose, and which are, in consequence, most valuable, are subjected to another process known as "skeining." This is the longitudinal division of the rod by splitting it into equal parts. The thick end of the rod is nicked with a knife, dividing the circle into three sectors. A triple wedge is then inserted, and the rod is drawn rapidly through the hand. The split rods are then drawn twice under a knife fixed to a gauge to remove the outer ring and inner angle, and the rod is reduced to a flat thin strip of equal thickness. These "skeins" are used for weaving sieve and riddle bottoms, and for making basket handles and similar articles. Green rods are "skeined" by the same process, for making eel grigs, hives, &c.

Hitherto the ordinary practice of most growers has been to sell the rods, when cut, to persons who peel, sort, and store them.

Information relating to the cultivation of osiers will also be found in articles by Mr. W. J. Cochrane in the Journal of the Highland and Agricultural Society of Scotland (5th Series, Vol. V., 1893), and by Mr. E. J. Baillie in the Journal of the Royal Agricultural Society of England (3rd Series, Vol. V., 1894); and attention may be directed to their remarks as to the suitability of sewage farms for the growth of osiers.

4, Whitehall Place, London, S.W.
May, 1893.

Revised, November, 1900.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of Application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Rabies.

The Board of Agriculture consider it desirable to give further publicity to the following paragraphs on the subject of Rabies, which have been extracted from the report of the Departmental Committee appointed by the Board to inquire into and report upon the working of the laws relating to Dogs.

The Committee report as follows :—

Rabies.

We have concluded from the terms of our reference and from the composition of the Committee that it was not intended that we should re-open the pathological question of the origin and nature of rabies, and throughout our inquiry we have acted on the assumption that the conclusion of the Select Committee of the House of Lords of 1887 was correct. That Committee reported "that it is practically "proved that subcutaneous inoculation with the virus of "rabies is the only ascertained means of imparting the "disease, and in order to check it every effort should be "made to prevent the dissemination of that infective "substance." We have, therefore, limited our inquiry to the examination of the efficacy of the existing system of dealing with rabies, and to the consideration of the means which may be taken by legislation or administration to make that system more effective.

Prior to the passing of the Dogs Act of 1871 (34 & 35 Vict. c. 56) the Acts of Parliament which dealt with the muzzling of dogs, and the disposal of rabid dogs, were mainly of a local character.

The Act of 1871, which is still in force, and applies to the United Kingdom, empowers the police to seize savage or dangerous dogs not under proper control, and authorises certain local authorities to impose restrictions on dogs not under proper control where a rabid or suspected dog is found within their respective districts.

In 1886 the Privy Council were empowered by the Contagious Diseases (Animals) Act of that year (49 & 50 Vict. c. 32 s. 8) to extend the definition of animals for the purposes of the Contagious Diseases (Animals) Acts, so that those Acts should comprise for all or any of the purposes of those Acts any kind of four-footed beasts, in addition to the animals mentioned therein. On the 16th September of that year the Privy Council issued the Rabies Order of 1886. A copy of this Order, which came into force on the 1st October 1886, is printed in the Appendix to the Committee's report, but it may be stated shortly that notification of rabies was made compulsory, that the necessary powers were conferred upon the local authorities to deal with cases of disease thus notified, and that those authorities were empowered to make regulations with regard to muzzling, the keeping of dogs under proper control, the seizure and disposal of stray or unmuzzled dogs, and the prohibition or regulation of dog shows.

This Order was re-enacted, with certain amendments of the powers conferred upon local authorities, by the Rabies Order of 1887, which took effect as from the 28th February 1887.

Local Authorities availed themselves of the powers conferred by these Orders, but not to any considerable extent.

In 1889 the Board of Agriculture was formed, and under the Board of Agriculture Act, 1889 (52 & 53 Vict. c. 30), the powers of the Privy Council under the Contagious Diseases (Animals) Acts were transferred to the new Department. The Board were at the same time empowered to make orders for the muzzling of dogs and the seizure, detention, and disposal of stray and unmuzzled dogs.

On the 9th July 1889 the Privy Council passed an Order which came into force on the 1st August, providing for the muzzling of dogs in the City of London and the Metropolitan Police districts, and later in the year this Order was repeated by the Board of Agriculture, and extended so as to comprise the counties of Cheshire, Lancashire, and the West Riding, and the whole of the counties of Essex, Hertford, Kent, London, Middlesex, and Surrey, with the boroughs locally situated therein. The new Order took effect from the 1st January 1890.

From time to time the Board made Orders extending the Rabies (Muzzling of Dogs) Order of 1889 to other districts, or, where the position with regard to disease had improved, granting an exemption from muzzling in favour of dogs wearing a collar. In 1892, however, the amount of rabies in the country had so considerably diminished that the Board passed Orders, as from the 1st November 1892, revoking all

former Orders, and again empowering local authorities to make regulations as to muzzling and at the same time imposing upon them the specific duty of seizing and disposing of all stray dogs found within their respective districts.

In 1894 the Contagious Diseases (Animals) Acts were consolidated under the title of the Diseases of Animals Act, 1894 (57 & 58 Vict. c. 57), and the Board of Agriculture re-issued the Rabies Order of 1892, with certain modifications, under the title of the Rabies Order of 1895.

It will be seen from the foregoing statement that recent experience with regard to rabies divided itself into two distinct periods. From 1889 to 1892 muzzling regulations were imposed by a central authority over wide areas, embracing the districts of numerous local authorities, whilst in the period from 1893 to the present time it has been practically left to local authorities to decide, each for themselves, whether or not muzzling regulations should be imposed.

A comparison of the two systems is of the first importance in the consideration of the lines upon which the law is hereafter to be administered, and the facts which such a comparison elicit are fortunately so striking as to leave no room for doubt as to the relative values of local and central control in this matter.

In the four years during which muzzling regulations made by the Board of Agriculture were in force the number of cases of rabies in dogs reported was as follows :—

In 1889	there were	312	cases.
„ 1890	„	129	„
„ 1891	„	79	„
„ 1892	„	38	„

Since the issue of the Rabies Order of 1892, and the practical relegation to local authorities of the duty of making muzzling orders, the disease has shown a very marked increase ; the number of cases reported has been as follows :—

In 1893	there were	93	cases.
„ 1894	„	248	„
„ 1895	„	672	„

In 1895, owing to the great prevalence of disease, muzzling regulations were more generally enforced by local authorities, and in 1896 there were in the 49 weeks ended the 5th December 422 cases reported as compared with 649 in the corresponding period in the preceding year.

Rabies in London has followed very much the same course as in the case of the country as a whole.

Muzzling regulations were in force in the county of London from August 1889 to October 1892. They were then withdrawn, but they were reimposed in February 1896. The number of reported cases was as follows :—

In	1889	there were	123	cases.
„	1890	„	32	„
„	1891	„	13	„
„	1892	„	3	„
„	1893	„	8	„
„	1894	„	12	„
„	1895	„	46	„

Since the re-imposition of the muzzle in February 1896, the number of cases for each month, up to and including November, has been February, 22 ; March, 21 ; April, 10 ; May, 11 ; June, 11 ; July, 11 ; August, 2 ; September, 1 ; October, 4 ; and November, 2.

It will be seen that the general results of the imposition of a muzzling order in London correspond with the results derived from the whole country, and we have reason to believe that the figures for every other area over which muzzling has been applied would teach the same lessons.

The number of deaths from hydrophobia in England and Wales in the same period presents similar features, and was as follows :—

In	1889	there were	30	deaths registered.
„	1890	„	8	„
„	1891	„	7	„
„	1892	„	6	„
„	1893	„	4	„
„	1894	„	13	„
„	1895	„	20	„

These statistics appear to us to fully confirm the views expressed in their evidence by the Chief Veterinary Officer and the Principal of the Animals Division of the Board of Agriculture, and to justify the conclusion, at which we have arrived, that muzzling is not only an efficient, but the only means which is now practicable, for the extermination of rabies, but that the powers of muzzling as exercised since 1892 by local authorities, acting in complete independence of one another, are inadequate to eradicate rabies, and only result in temporary and local checks to its spread. As the Principal of the Animals Division of the Board of Agriculture stated in his evidence : " The disease will continue to " rise and fall in waves unless it is altogether eradicated," and " so long as the public look upon it with indifference " the disease will rise : so soon as they begin to be at all " alarmed, then the necessary steps will be taken to decrease " it."

The futility of the system which has been in operation since 1892 largely accounts, in our opinion, for its unpopularity. It produces the maximum of local irritation with the minimum of general and permanent good. Surrey naturally grumbles at the retention of a muzzling order within its limits, when Berkshire, co-terminous with it, is permitting its dogs to go unmuzzled, even although an outbreak of rabies may have occurred much closer to the Berkshire boundary than are a very large number of the dogs required by Surrey to be muzzled.

The state of things in Lancashire and the West Riding of Yorkshire is still more striking. In each of these counties the county area is studded with borough islands, Lancashire being governed in this matter by no fewer than 34 separate local authorities, and the West Riding by 16. Each one of these separate local authorities imposes or remits muzzling orders according to its own pleasure and convenience, often without regard to the action of neighbouring authorities or to the general weal of any large tract of country.

On the other hand, the Board of Agriculture, under the law as it stands, have the power and the machinery necessary to enforce muzzling in a general and systematic way, and experience has shown that by the exercise of the functions vested in them as a central authority, the suppression of cattle plague, foot-and-mouth disease, and pleuro-pneumonia has been obtained.

We think, therefore, that the time has come and that the circumstances are opportune for the Board of Agriculture to make a determined and systematic attempt to stamp out rabies.

This will not, in our opinion, involve universal muzzling, inasmuch as there are districts where rabies has never appeared.

What is necessary is that the Board of Agriculture should have regard to the country as a whole and should impose muzzling over considerable areas, irrespective of the boundaries of boroughs and counties, that the Board should impose it, in fact, where it is really required and leave the rest of the country free. We believe that much of the feeling against the present capricious and ineffective system of partial and uncertain muzzling will not show itself against the operation of a centralised system carried out on well-considered lines and effectively producing the result which all desire to see achieved, viz., the suppression of rabies.

We confidently hope that our proposal will achieve this result, and that it will then become unnecessary again to resort to a measure, the inconvenience of which we fully recognise, but which we now recommend as the one practical means to a much desired end.

The complete report [C. 8320.] of the Departmental Committee on Laws relating to Dogs, can be purchased (price 2*d.*), either directly or through any Bookseller, from Messrs. Eyre and Spottiswoode, East Harding Street, Fleet Street, E.C.; or Messrs. John Menzies & Co., 12, Hanover Street, Edinburgh; and 90, West Nile Street, Glasgow; or Messrs. Hodges, Figgis & Co., Limited, 104, Grafton Street, Dublin.

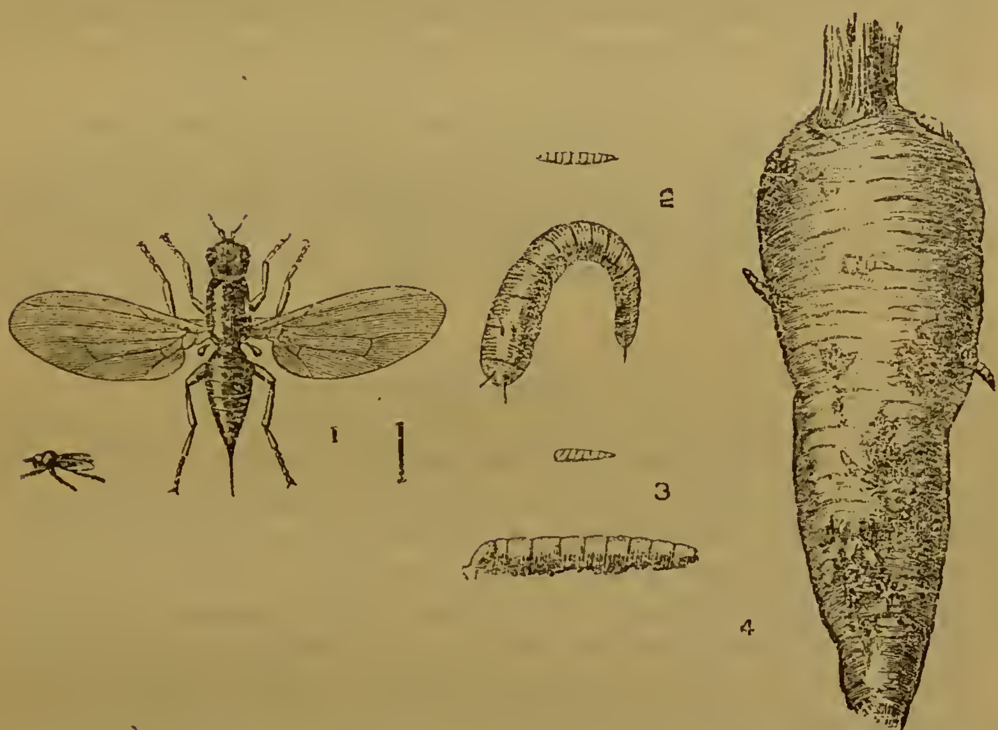
4, Whitehall Place, London, S.W.
March, 1897.

This leaflet is no longer issued.

Leaflet No. 38.

BOARD OF AGRICULTURE AND FISHERIES.

The Carrot Fly (*Psila rosæ*).



1. Fly, natural size and magnified; 2. Larva, natural size and magnified; 3. Pupa, natural size and magnified; 4. Infested carrot showing "rust" spots.

Carrots are frequently much injured by the larvæ or maggots of this fly, which bore into and feed upon their roots, living upon them and causing them to become brown or "rusty," and finally rotten. In some cases of early attack the growth of the small roots is entirely stopped. Carrots grown by market gardeners and market-garden farmers for "bunching," or pulling early, are not often materially injured, as the fly does not, as a rule, attack them until the end of May, though the latest of these early pulled roots are sometimes disfigured and their value depreciated because of the rusty spots made by the maggot. But those that are dug late for storing, either for human or for cattle food, are very frequently seriously damaged, and rot in the clamps and stores, and are rendered unsaleable by reason of the rust marks upon them. It has been noticed that the carrot fly is more injurious in dry seasons, when the growth of the

roots is not so luxuriant and rapid as when moisture is plentiful. The rain also closes the soil, and this may in some degree hinder the fly from laying eggs, the female requiring to go underneath the earth for this purpose.

Carrots badly attacked by this insect sometimes have deep cracks in the roots in which the larvæ are found. These frequently extend to the centre of the roots and cause them to rot. The tops become pale in colour and wither away, and in the early stages of the attack, when as yet there are only a few larvæ in the roots, the foliage changing colour, and turning reddish, betrays their presence. When these indications are noticed it will generally be found upon pulling up the roots that larvæ are protruding from the holes in them (Fig. 4). In bad cases of infestation, decay is frequently hastened by the attacks of millipedes attracted by the unhealthy state of the roots, and by slugs and wood-lice (" Slaters "). The maggots of the carrot fly often remain in the roots after they have been stored and continue to injure them for some time. They have also been reported as attacking turnips in Germany, and celery in the United States.

Description.

The carrot fly is shiny black or dark green in colour and about the fifth of an inch long, with a wing expanse of nearly half an inch. The wings are iridescent, and have dark yellow veins. The head is round, of a reddish yellow colour and very sparingly covered with hairs. The eyes are black. The legs are of a light yellow colour. There is not much difference between the male and female, except that the body of the latter is more pointed than that of the male, and is furnished with a long retractile ovipositor or egg-laying tube.

The maggot is without legs, yellowish in colour, and nearly a quarter oi an inch long. It has no distinct head, but its fore-end tapers to a point, in which there are two claw-like hooks for biting and boring. The hind end is blunt.

The puparium, or pupa-case, is light brown in colour, horny and striated. Its front end is somewhat pointed; the hind end is rounder and bears two small black points.

Life History.

In the spring the flies appear, and may be seen upon the lower leaves of trees and bushes, especially near brooks and streams. When the carrot roots are well established the flies lay eggs upon them just below the ground. All authorities agree that the eggs are laid below the surface of the ground, but none have actually observed how deeply the fly goes down for this purpose. It is believed that it is only just below the surface, and that the maggot when hatched goes

down instinctively to the lower part of the carrot, as the root is softer there and more easily penetrated. When it has gained an entry the maggot works upwards and makes passages, with frequent holes to the outside. When young the maggots especially attack the outer parts of the carrot. When full fed they leave the root for pupation in the soil.

There are several generations during the summer. Kühn and Ormerod state that the series of changes is accomplished in between three and four weeks, but in parts of Great Britain it takes very often five weeks. The last generations for the most part remain in the earth in the chrysalis stage.

Methods of Prevention, and Remedies.

1. When it is noticed that the tops of carrots change colour prematurely, the roots should be examined, and those that are infested must be forked up so that no part of them is left in the ground, and destroyed. This will prevent further infestation.

2. If the flies are seen near or on the carrot plants these should be sprayed with paraffin emulsion. The emulsion is made thus :—Dissolve half a pound of soft soap in a gallon of boiling water ; while this is still boiling hot pour it into 2 gallons of paraffin, and churn thoroughly until a butter like mass results. If this be well made it keeps for a long time. For use here dilute with 20 parts of water. It is better if possible to use soft water in making the emulsion. This emulsion can be put on by means of a knapsack machine, or in large fields by a horse distributor.

3. The following has proved an excellent preventive measure :—Spray the carrot bed, after sowing, with the paraffin emulsion, spray again with it after germination, and a third time after thinning.

4. In places where these flies cause injury, ashes, sawdust, sand, or wood-ashes, impregnated with paraffin oil at the rate of from three to four quarts per cwt. may be put into the drills with the seed. Curtis recommends a gallon of spirit of tar to a barrowful of sand for this purpose.

5. Pressing the earth close round the stems tends to prevent the flies from egg laying. This may be done immediately after the plants are singled, by men or boys treading both sides of the rows.

6. Heavy watering of the crop after thinning tends to consolidate the soil, and so ward off attack.

7. Sand or ashes, impregnated with paraffin or carbolic acid, may be scattered over the plants at singling time to keep

the flies from them. The great object must be to prevent the flies from laying eggs on the carrots, and for this purpose offensive substances, such as soot, earth, ashes or sand, sprinkled with carbolic acid, might be applied as soon as the plants are well established.

8. It is a matter of common observation that carrots that have sprung up singly on paths or the like, from seed accidentally dropped, are seldom attacked. Apparently the operation of thinning is, in many instances, the predisposing cause of attack, and this has led some growers to sow the seed very thin, and so to avoid the artificial thinning of the crop.

9. After an infested carrot crop has been removed, the land should be trenched in gardens, and very deeply ploughed in fields. A good dressing of finely powdered gas lime should be applied before the land is dug or ploughed in the ordinary way. The time separating two carrot crops on the same land should be made as long as possible, and recourse should, as frequently as opportunity offers, be made to the cultivation of this crop on fresh ground.

10. Where carrots happen to have been stored in earth, measures should be taken so that any puparia, or maggots which have left the carrots to pupate, may be destroyed.

11. In localities where the attack of the fly is very prevalent a supply of carrots can usually be maintained, (*a*) by sowing such early varieties as French Forcing in a sheltered position as soon as the soil and weather permit in February or March, for early use, and (*b*) by deferring the main crop sowing until mid-July, choosing the Early Horn variety, which will grow sufficiently large for storing for winter use. The plants from the first sowing develop before the egg-laying period of the fly, whilst egg-laying is over before the plants from the late sowing appear above ground.

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BOARD OF AGRICULTURE AND FISHERIES.

Assessments to Land Tax.

The Board of Agriculture and Fisheries consider it desirable to give publicity to the following Memorandum, prepared under the authority of the Board of Inland Revenue, directing the attention of owners of land and other persons to the method by which assessments to land tax are now made, and to the procedure to be followed in cases where persons who may think themselves over-rated to the tax desire to make an appeal.

Memorandum as to Land Tax in England and Wales.

1. The land tax is an apportioned tax. It is not charged at the same rate in the pound over the whole country, but each parish is liable to contribute a fixed annual quota. The parochial quotas were fixed permanently and made perpetual by the Land Tax Perpetuation Act, 1798, but subject to redemption.

2. The land tax quota payable is required by law to be raised in each parish by a new assessment yearly and from year to year at an equal rate on the annual value of all lands and tenements, etc., which have not been exonerated from land tax (Land Tax Redemption Act, 1802, section 180). Such lands and tenements are to be charged "with as much equality and indifference as is possible by a pound rate" (Land Tax Act, 1797, section 4).

3. Formerly the maximum rate of land tax chargeable was 4*s.* in the pound (Land Tax Redemption Act, 1802, section 180). Now, by the provisions of the Finance Act, 1896, section 31, the amount assessed may not exceed the amount which would be produced by a rate of 1*s.* in the pound on the "annual value." For the purposes of that section "annual value" is the annual value as assessed under Schedule A. in the Income Tax Act, 1842, and if an assessment so made on a parish is insufficient to raise the amount of the parish quota the difference has to be written off as irrecoverable.

4. The assessment of the land tax rests exclusively with the Land Tax Commissioners for each division, and any complaint against a land tax assessment on the ground of

inequality or incorrectness must be by way of appeal to them. Notices as to when appeals will be heard are annually fixed early in the financial year to the church door in each parish. The collectors of land tax are required, upon the application of any person who may think himself over-rated, to permit such person, or his proper representative, to inspect the duplicates of assessment at all reasonable times in the day, without payment of fee. Every person intending to appeal is required to give notice of his intention in writing to one or more of the assessors. Appeals once heard and determined by the Commissioners are final.

5. If an owner in possession of the rents and profits of any lands, etc., in any financial year before payment of the land tax assessed on such lands, etc., produces to the collector of land tax a certificate from the surveyor of taxes—(1) that he has been allowed in that year a total exemption from income tax by reason of his income not exceeding £160, the land tax assessed on such lands, etc., will not be collected—or (2) that he has been allowed in that year an abatement of income tax by reason of his income not exceeding £400, one-half of the land tax assessed on such lands, etc., will not be collected.

6. Any person having an estate or interest in lands and tenements (except tenants at rack rent, or holding under the Crown) may contract for the redemption of the land tax charged thereon. By the Finance Act, 1896, the consideration for the redemption has been fixed at thirty times the amount of the tax.

7. Information as to redemption may be obtained from the clerk to the Commissioners of Taxes for the division in which the land tax desired to be redeemed is assessed, or (by letter) from the Registrar of Land Tax, Inland Revenue Office, Somerset House, London, W.C.

No fee is payable by a redemptioner for such information.

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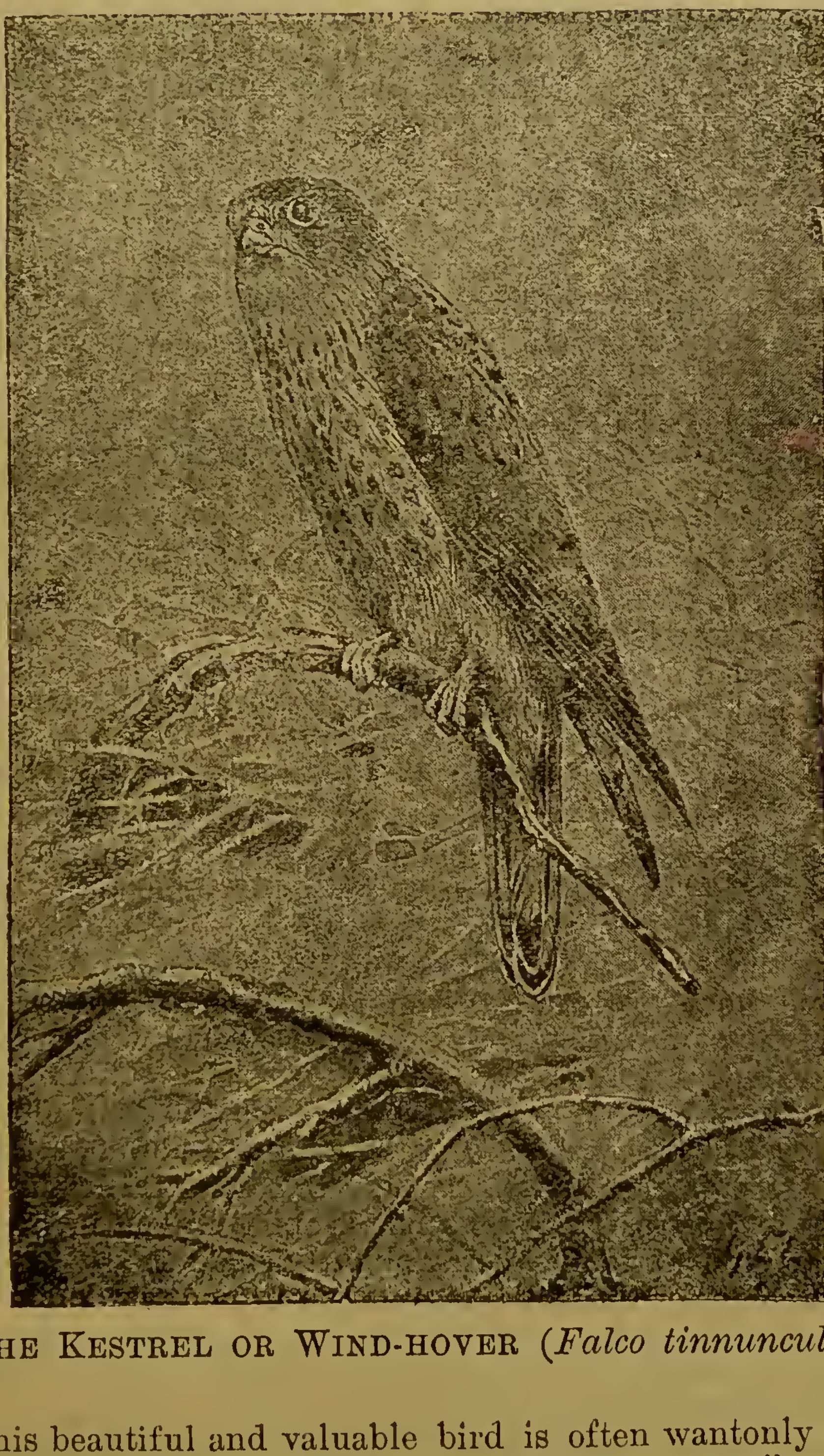
BOARD OF AGRICULTURE AND FISHERIES.

The Kestrel or Wind-hover (*Falco tinnunculus*).



THE KESTREL OR WIND-HOVER (*Falco tinnunculus*).

This beautiful and valuable bird is often wantonly killed either for the sake of shooting at "something wild," and the

pleasure of seeing it stuffed and set in a glass case, or because of an exaggerated idea on the part of gamekeepers that it is a systematic destroyer of young partridges and pheasants, grouse, hares, and rabbits.

The wholesale destruction of such birds as the Kestrel is frequently the main cause of abnormal and sudden attacks upon crops by animals and insects. In favourable conditions of climate and other circumstances, and in the absence of the checks provided by nature against their undue increase, certain animals multiply exceedingly and do infinite harm, as was exemplified by the serious injury occasioned to grass-land in parts of Scotland by voles in 1892. Insects also appear more frequently and in larger numbers in these later days owing in some degree to the destruction of certain birds, their natural destroyers.

The Kestrel prefers animals of the mouse tribe to all other forms of food. Yarrell, in his *History of British Birds*, says, "Mice form the principal part of the food of the Kestrel." It also feeds on beetles, especially cockchafers, and on caterpillars, and also devours frogs. When it cannot get mice it will occasionally take very young birds, as pheasants, partridges, and grouse, but according to all observers it preys chiefly upon mice and insects; and in the report of the Departmental Committee, appointed by the Board of Agriculture to inquire into a plague of field voles in Scotland in 1892, it is stated that the food of the Kestrel is known to consist almost exclusively of mice, grasshoppers, and coleopterous insects.

Keepers do not always discriminate between hawk and hawk, and because some other hawks, as the Sparrow-hawk, for instance, take young game birds, it is often erroneously concluded that the Kestrel is equally an offender in this respect. In the report referred to above, it is observed, in connection with the question of the Kestrel's habits, that it is rare to find people able to distinguish between one kind of hawk and another. Few of the witnesses who gave evidence before the Departmental Committee were able to describe hawks otherwise than as red, blue, brown, or yellow, and it was often found impossible to make out what species they intended to indicate.

The identification of the Kestrel is easy on account of its practice of hovering in the air, without motion, for a long time. Its graceful flight is also different from the rapid dashes of the Sparrow-hawk. It is about fifteen inches from head to tail, the female being slightly smaller.

The colour of the Kestrel is reddish-brown to pale-chestnut, with small black or bluish-black bars or spots on the back, according to sex, the male having spots, the female bars. The under parts are buff, streaked and spotted with black. The head, neck, the lower back, and tail are bluish-grey in the male. The tail is edged with white below a broad black

band, while in the case of the female there are several dark bands on the tail. The beak is blue, except the base (cere), which is yellow, as also are the legs and feet. Old females often partially assume the appearance of the male.

The Kestrel seldom, if ever, builds a nest, but makes use of the old nest of a crow, rook, magpie, or similar bird, or else lays its eggs in cavities in cliffs, quarries, chalk-pits, hollow trees, or buildings. They have now and then been known to lay eggs on the ground. The eggs are usually laid in the latter half of April, and vary from four to six in number. They are yellowish-white mottled with deep brownish-red patches. During their first year the young resemble the female, but are a little lighter in colour.

There is testimony from many writers as to the value of the Kestrel to the agriculturist as a mouse destroyer, notably from Charles Waterton and White of Selborne. Amongst continental authorities Professor Ritzema Bos speaks of the great usefulness of the Kestrel to cultivators in Germany; and in France, according to Brocchi, it is also highly valued.

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BOARD OF AGRICULTURE AND FISHERIES.

Red Spiders (*Tetranychus*, *Bryobia*, and *Tenuipalpus*).

1, A full-grown Red Spider. 2, Immature mite, with six legs. 3, Egg. All much magnified.

One of the families of Mites, the *Tetranychidæ*, sometimes known as Red Spiders or Spinning Mites (many of the species can spin silken threads) contains three genera troublesome to plants, viz., the genera *Tetranychus*, *Bryobia*, and *Tenuipalpus*. These may be thus distinguished :—

Tetranychus has a somewhat pear-shaped body, which is half as long again as broad, the front pair of legs being longer than the body.

Bryobia has the two front legs not only longer than the body but distinctly longer than its other legs.

Tenuipalpus has short heavy legs.

The damage is in all cases due to the piercing of the plant tissues by the sharp mandibles.

A species of red spider sometimes causes serious injury in hop plantations. In 1868, and again in 1893, this pest did much mischief in many hop grounds. The leaves fell off, the burr or blossom did not develop into cones, and, in some instances, the plants were completely shrivelled up. In most seasons, at least in those in which rainfall and temperature are normal, a few spinning mites can be found upon the large leaves of the hop plants, especially where the soil is shallow, but in the two years just mentioned they multiplied with wonderful rapidity. They were found upon the small leaves high up the poles, also upon the burr, and even in the cones themselves. The lower leaves when attacked turn yellow, and the yellowness fast spreads up the bine. Upon the under-surfaces of the leaves thick webs are spread from rib to rib, under which the mites are seen actively sucking up the juices. All sorts and conditions may be

to have a prejudicial effect on the mites, and it is believed that this is of little if any benefit. Hop plants are sulphured almost in the ordinary course of cultivation, but the mites are not hindered by this in the least degree. Leaves have been examined upon which the webs of the mites were thickly covered with particles of sulphur, aud the mites in the webs immediately in contact with the sulphur were lively and unconcerned. Paraffin emulsion to which liver of sulphur has been added has been of considerable effect if used in the early stages of the attack. This is made by mixing 6 lbs. of soft soap and 7 gallon of parraffin with 100 gallons of water. The soap is dissolved first in boiling water and poured into a tub containing the paraffin, the whole being churned up with a force pump. The mixture is afterwards diluted to the proper strength. It is important that the water used for this emulsion should be soft; it can be made soft by adding soda or borax. Sulphide of potassium, known commonly as liver of sulphur, is added at the rate of 2½ lbs. to 100 gallons of wash. Liver of sulphur may be used alone, but it is best used with paraffin emulsion. As this wash does not affect the eggs it must be applied twice or three times in succession at intervals of three days. It should always be applied with force.

For vines, cucumbers, melons, &c., liver of sulphur is best used mixed with quassia wash. Sulphur mixed with water and painted on the hot-water pipes is often employed in conservatories. With such a use of sulphur care must be taken to maintain a proper degree of moisture in the greenhouse. Apart from the danger of this treatment of the atmosphere of the house be dry, one of the great causes of the prevalence and multiplication of Red Spider is overheating and overdryness, and where forcing is practised and the temperature is therefore high the question of moisture should be attended to. Under glass, fumigation with tobacco is a common and usually a fairly effective remedy.

Liver of sulphur is also a remedy for some fungoid affections of plants, and would probably be more efficacious than sulphur applied in the form of a powder. It is so soluble that it may be easily incorporated with most insecticides.

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BOARD OF AGRICULTURE AND FISHERIES.

The Short-Eared Owl (*Otus* [*Strix*] *brachyotus*).

THE SHORT-EARED OWL.

Otus brachyotus (*Strix brachyotus*).

The Short-Eared Owl is different in its habits from other owls found in Great Britain, which live in thick woods and plantations, or in barns, churches, and ruins, and seldom leave their retreats during the day. The haunts of the Short-Eared Owl are heath and moorland, marshes, furzy downs, meadows, turnip fields and open places, principally

in the north of England and Scotland, though it is found occasionally in many English counties. It flies in the daytime as well as at night. Its food consists of mice, voles, rats, small birds, fish, reptiles, large insects, and occasionally bats. Prentis, in his *Birds of Rainham* (Kent), says that the Short-Eared Owl is not uncommon and comes in the autumn. It visits the marshes, where it is safe, nearly every year. When partridge shooting, sportsmen have met with these owls in Kentish turnip-fields. On one occasion a pair nested and succeeded in hatching their young on an island marsh which had been lying idle throughout the winter and spring. But this owl, being migratory, does not, as a rule, breed in Great Britain; it leaves this country at the beginning of the spring for many other countries, so that, to use Seebohm's words, outside our islands its range is almost cosmopolitan. It is found in such different latitudes as the Sandwich Isles and Greenland. Sometimes, however, as ornithologists relate, its nest is found in this country, especially in districts where there has been an extraordinary supply of its favourite food—mice, voles, or rats. In Gloucestershire, for example, when there was a great plague of mice in the Forest of Dean, Short-Eared Owls were attracted there in large numbers and materially assisted in destroying the intruders.

The Departmental Committee, appointed in 1892 by the Board of Agriculture to inquire into a plague of field voles in the south of Scotland, say in their report, "This bird (*i.e.*, the Short-Eared Owl), which is distributed over almost every part of the globe, is a normal winter migrant to these islands, appearing simultaneously with the woodcock (whence it is popularly known as the 'woodcock owl') and usually departing in spring. Nests in ordinary seasons are of comparatively rare occurrence in Great Britain, but in consequence of the vast multiplication of their favourite food, the vole, these owls have not only arrived in unusual numbers but have remained and bred freely all over the district affected, laying from 8 to 13 eggs (though Newton in his edition of Yarrell's 'British Birds' mentions seven as an unusual number) and rearing more than one brood. The shepherd on Crooked-Stone, near Crawford, has counted 14 nests on his ground. The small wood behind the farmsteading of Howpasley presented a remarkable appearance, the ground being densely covered with the pellets (or 'castings') of owls composed of the fur and bones of the voles."

The Committee were of opinion that it would be difficult to condemn too severely the foolish and cruel action of those who allow or encourage the destruction of this useful and beautiful bird, and it was with much satisfaction that they were able to record that many land owners and game preservers had become convinced in late years that owls of

all sorts are not only harmless to game, but most beneficial to agriculturists, and had issued orders for their preservation. Seebohm also writes strongly on this point : he says, "Too often, however, the poor harmless owl is shot down by the thoughtless farmers, or ignorant gamekeepers, who foolishly imagine they are ridding the domains of a pest, although in reality they are taking the life of one of their most valuable friends."

The Short-Eared Owl is from 14 to 15 inches in height. The female is rather larger than the male. The head, back, and wings are lightish brown with darker brown patches upon them. The wing feathers have an edging of light buff or fawn colour, and the under surface of the body is of this colour with blackish markings upon the breast. The legs are pale buff and the toes black. The beak is also black, and the ears, as well as the tufts of feathers on the head, are brown. The eggs are creamy white in colour, and about $1\frac{3}{4}$ inches long by $1\frac{1}{4}$ inches in breadth. They are deposited on the ground in a nest scooped out of the earth and lined with a little dry grass or moss. The nest is made generally in tufts of heather or furze, or on the top of a clump of sedge or reeds in fenny districts. Nests have been occasionally found in the Kentish marshes on little hillocks covered with rushes. From six to eight eggs are generally laid, but, as was shown by evidence before the Committee cited above, as many as 13 eggs have been found in a nest. Seebohm, in his "Far Countries of North America," quotes Richardson to the effect that this species of owl lays as many as 10 to 12 eggs.

The Short-Eared Owl is much appreciated in Germany, where it is called the "moor," "fen," and "meadow" owl. It occasionally breeds in Germany as in England, but generally arrives in September and remains till March. In France it breeds in the Pyrenees, Charente Inférieure, Hérault, Tarn, Aube, and other Southern Departments, but not very extensively.

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BOARD OF AGRICULTURE AND FISHERIES.

Titmice (*Paridæ*).

THE GREAT TITMOUSE (*Parus major*).

All the titmice are more or less active hunters of insects, for which they are constantly on the watch, and no inhabitants of the insect world come amiss to them as food. They are especially useful in the destruction of many crop pests, which they devour in all stages. During the winter they clear off enormous quantities of eggs which have been deposited by insects of various kinds in or near buds, and in the clefts of the bark or rind of trees. At this season the titmice may be seen frequently running up and down the trunks, stems, and branches, or hanging head downwards from the smaller branches and twigs, prying anxiously into each crevice and fold of the rind, in search of eggs, hibernating larvæ, or perfect insects. Their sight is so keen that they can detect such small eggs as those of the Winter Moth, and they have been seen actively devouring the minute red eggs of the mite *Bryobia* upon the stems and branches of gooseberry bushes and damson trees.

It is sometimes alleged that the tits, like the sparrows, wantonly pick out the buds of trees and shrubs; but this accusation is wrong, and based upon insufficient investigation

of the circumstances, as titmice only attack buds that are diseased.

The Crested Tit (*Parus cristatus*).

The Crested Tit is a pretty little bird, but it is very scarce and decreasing in numbers, forests in the north or north-east of Scotland being its chief and almost only habitat in Britain. It can be recognised by the feathers of the head being prolonged into a crest, black in colour but edged with white, and by the black streak which runs backwards from each eye and then round the cheeks. The crest of the female is not so conspicuous. Nesting takes place in May; eight eggs are laid, white in colour and spotted with red. The Crested Tit feeds on insects and weed seeds, and should be carefully preserved.

The Coal Tit (*Parus ater*).

Living as it does chiefly amongst pine and birch woods, often far from houses, the Coal Tit is not so well known as the Great Tit and the Blue Tit. It is, however, as great a destroyer of insects as the other members of the same family, and should be rigorously preserved. It is found throughout the British Isles.

The Coal Tit is rather more than four inches long. Its general colour is bluish grey, with a dull white breast, and it may be distinguished from the Marsh Tit, which it somewhat resembles in colour and size, by a large white patch on the back of the neck and by the two white bars on the wings. It usually makes its nest in holes in trees; but it occasionally nests in burrows and holes in the earth made by rabbits and other animals. The eggs are white, spotted with red-brown.

The Marsh Tit (*Parus palustris*).

This Tit is occasionally seen in gardens and orchards, principally in the winter, but its chief habitations are low-lying meadows and damp situations, where it nests in holes in old willow-trees and other trees, pollards, and stumps, very close to the ground. After *Parus cristatus* it is the least common of the Tits. Like the other British Tits it is insectivorous, though Yarrell states that it is also partial to the seeds of the thistle. The young keep together for some time after they are fledged.

According to Seebohm it may be seen in almost every conceivable position searching for insects on the buds at the end of a branch. It is slightly smaller than the Coal Tit, its head is bluish black, the sides of the neck are white, the under part of the body is light brown while the upper part is olive-brown, of varying shades. The 5 to 8 eggs are greyish white speckled with brown.

The Great Tit (*Parus major*).

Two of the tits are especially useful to agriculture, because they are not only more numerous than the other members of the family, but they live near human habitations, and are found in every garden and orchard. The first place in point of size may be given to the Great Tit, which is a voracious devourer of insects of all kinds and in all stages. It is indefatigable in search of food, and may often be observed climbing the trunks of trees, or hanging suspended from the under surfaces of branches while examining every cavity, leaf, or bud that is likely to afford shelter to any of its numerous insect-prey. These tits have been observed in numbers upon and under oak trees, pecking to pieces the galls for the sake of the insects within. Late in the autumn, small seeds and fruit form part of its diet, but its young are fed entirely on small caterpillars and grubs. Apart from the courage displayed by the Great Tit in defence of its young it has been seen to attack and kill other small birds.

The Great Tit, called also the Ox-eye, is a beautiful bird about six inches long, and usually builds its nest in holes in walls, trees, decayed posts, and similar places. Six, seven, or eight is the average number of eggs, which are white, sometimes a faint yellow, and spotted with red. The head and throat of the Great Tit are glossy black, with a white patch under each eye. The back is olive, or ashy green, and the body underneath is greenish yellow with a broad stripe of black down its entire length.

The Blue Tit (*Parus cœruleus*).

This elegantly feathered little bird is the most useful of all the tribe of tits. It is about four-and-a-half inches in length, and happily, distributed generally throughout the country. The wings and tail of this species are blue, the breast and belly sulphur-yellow, the back yellowish green, and the side of the head white with a blue band running across it from the beak to the nape. Its nest of moss, hair, and feathers is built in holes in trees, walls, or gate posts, and sometimes in pumps, letter boxes, and other extraordinary places. The egg are six to nine in number, and are white, spotted with light red. Insects appear to be the principal objects of its search during the summer. Naturalists who have watched these birds saw nothing but small grubs and caterpillars brought to the young ones from apple trees near. In the winter this tit feeds upon seeds, eggs and pupæ of insects, and anything it can pick up.

The Long Tailed Tit (*Aegithalus vagans*).

This tit which is abundant in the southern and south-western counties of England, but not so common in the

north, is also beneficial. It is about four-and-a-half inches long, and builds a most elaborate nest, shaped like a bottle, from which this bird is known familiarly in some localities as the "Bottle Tit." The nest, which is built in thick bushes or dense shrubs, has a very small hole in the upper part of the side. The eggs vary in number from ten to sixteen and are white with faint red spots. It is stated that this bird is more decidedly insectivorous even than the other species of tits. Brocchi maintains that it feeds entirely on insects in France, and that it and all the species of tits have a right to the protection of agriculturists, to whom they render important services. He estimates the annual consumption of each of these birds at nearly 200,000 insects in the form of eggs and larvæ, and remarks that when they attack the buds of fruit trees, an offence with which they are sometimes charged, it is certain that there are insects or mites within these buds.

The head, breast and neck of the Long Tailed Tit are whitish, with black bands or stripes. The back is black, mixed with rose colour, and the wings and the very long tail are black edged with white.

THE BLUE TIT (*Parus cœruleus*).

There is no doubt that the Great and Blue Tits occasionally damage apples and pears by pecking holes in the base; and it is believed that this may occur even when no insects are in the fruit. This destructive habit can easily be

checked by growing rows of sunflowers in and around the orchards. The Tits feed greedily on the seed, and are thus kept away from the fruit; and at the same time they are attracted to the orchards where they do much good in checking insect depredations. In a case where the Blue Tit damaged the pear crop by perching above the stalk of the nearly ripe fruit and pecking it, so causing the pears to fall, protection was afforded by the use of small shields of cardboard. The pears were large and valuable and were being grown on bushes; cardboard shields were cut two inches square, with a hole in the centre and a slit on one side so that they could be fitted round the stalk of the pear. The Great Tit also attacks nuts; but the good it does in devouring the nut maggot outweighs the harm it now and again does to the sound nuts.

So beneficial in every sense are the Tits that everything possible should be done to encourage their increase. In winter, during severe weather, they should be supplied with some food, *e.g.*, fat, acorns, or beech nuts. Where old trees and walls are abundant the Great and Blue Tits usually find ample opportunities for nesting, but under other circumstances, the birds may be rare or altogether absent, owing to their inability to find nesting places. In such a case much may be done by fixing up rough boxes in suitable places, care being taken (*a*) that they are placed beyond the reach of cats, (*b*) that they are as inconspicuous as possible, and (*c*) that the entrance hole is not large enough to admit sparrows. It must be said, however, that Tits do not take nearly so readily to artificial nesting places as some other birds, notably Starlings.

4, Whitehall Place, S.W.,
August, 1897.
Revised, August, 1905.

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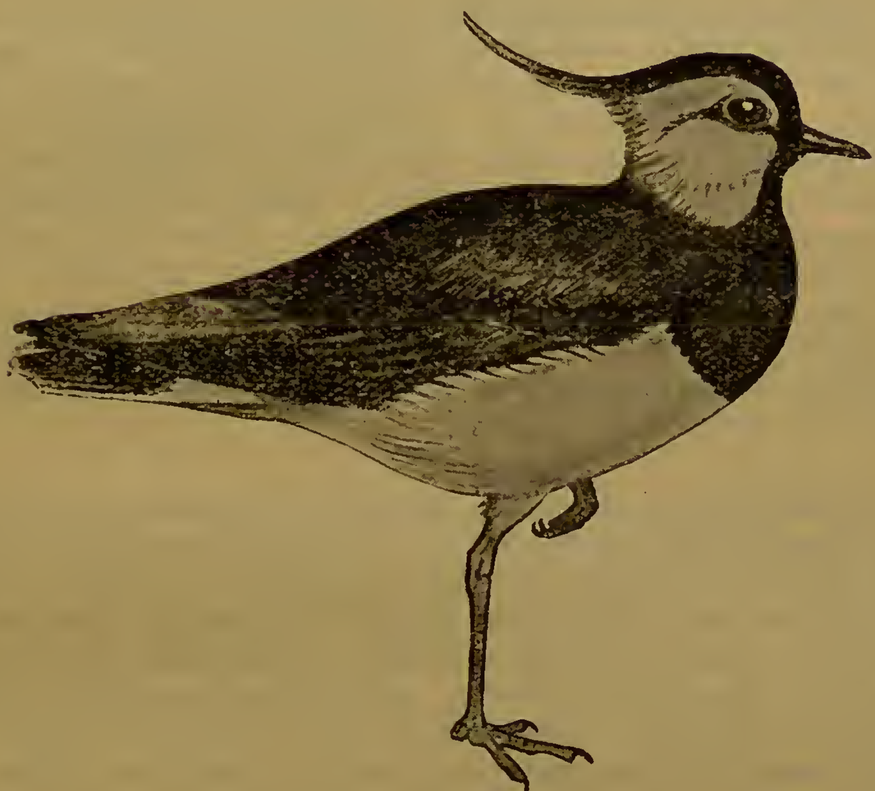
BOARD OF AGRICULTURE AND FISHERIES.

The Lapwing, Green Plover or Peewit.

Vanellus cristatus.



This bird is familiar to most persons in Great Britain and Ireland, being found in every county. It breeds in marshes, moors, meadows, and fallows, and is seen in large flocks in the autumn and winter, but in the breeding season the flocks are not nearly so large as at other times of the year. Large numbers arrive every autumn from the Continent. In the adult bird the beak, crown of the head, and the erectile crest are greenish-black ; the back and wing coverts are also green-black, tinged with purple and copper-colour ; the sides of the neck are whitish, and the lower part of the breast and the belly are white ; the wing quills are black ; the feathers of the tail are white, a broad black band showing near their tip. In winter the throat becomes white and the head dark brown. The bird measures a foot in length.

The nest of the lapwing or peewit is a mere hole or depression in the surface of the ground, either in grass land or arable land, sometimes with a few bits of dried grass, bents, or rushes at the bottom. Nesting takes place at the end of March. The olive-coloured eggs with black-brown blotches, familiar to everyone, are usually four in number, and are keenly sought after in districts frequented by these birds, to supply the great demand for them as luxuries of diet. Such high prices are paid for plovers' eggs, especially in the early part of the season, that the natural increase of the birds is largely interfered with, and the multiplication of insects injurious to crops is the consequence.

No bird is more beneficial to cultivators than the Lapwing. It devours snails, wireworms, beetles, and larvæ of various insects that infest grass, turnips, wheat, and crops of other kinds. As it feeds in the evening, it has opportunities of taking many insects which commit their depredations after sundown. On account of their insectivorous habits lapwings are sometimes kept in gardens, where their valuable services are highly appreciated. They are of great benefit to sheep owners by eating the water snail of the species *Limnœa truncatula*, as this snail is the intermediate host of the liver fluke (*Distomum hepaticum*) which produces the liver-rot in sheep.

Lapwings are, fortunately, protected in close time throughout Great Britain by the Wild Birds' Protection Act of 1880. The eggs are protected, by the adoption of the Wild Birds' Protection Act, 1894, after April 15th in all counties in Scotland; and in a few counties in England the second brood of eggs is protected by prohibiting the taking of their eggs after May 1st. The following testimony of Curtis, the great economic entomologist, may be cited in favour of these birds:—"In the marshy districts of our Eastern counties," he says, "the plover, or lapwing, called also 'pewit,' was formerly exceedingly abundant, as well as the ruff and ree, but the gun and nest-hunter have so thinned their numbers that the lapwing is becoming scarce, and the latter have almost abandoned our shores, and as might be expected, the Wireworms seem to be increasing rapidly in such localities. On opening the lapwings that have been shot, their crops were full of Wireworms; and as it is supposed that one bird would eat a hundred in a day, the flocks of forty, fifty, and upwards that were constantly to be seen some years since would clear off a very large number in a season. Their assistance, however, is departed and gone for ever, for the high price which the eggs fetch in the market causes the peasantry to look so carefully after the nests, that the only chance the lapwing has of

escaping destruction is to seek the wildest districts of Scotland and Ireland, where, their eggs not being so essential a luxury as they are considered in England, they may escape the persecution they have so long endured. Whether the destruction of late years of whole fields of corn at Oxborough, near Stoke in Norfolk, is attributable to the absence of these birds, I cannot say, but it is certain that formerly the plover abounded in that neighbourhood, and now scarcely a pair can be seen." Since Curtis wrote these words,* the demand for lapwings' eggs has greatly increased, and the annual search for them is even more persistent than it was fifty years ago. In the agriculturist's interest the eggs should be protected in all counties.

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* Journal of the Royal Agr. Soc., 1844, Vol. V, Part I. p. 208.

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BOARD OF AGRICULTURE AND FISHERIES.

The Starling (*Sturnus vulgaris*).

The starling is so well and widely known throughout Great Britain and Ireland as hardly to need description. It is nearly $8\frac{1}{2}$ inches in length. The beak of the adult male is yellow; the head, neck, and back, and all of the under part of the body are glossy black, with metallic purple or green tints; the feathers on the upper parts are tipped with buff or dead gold colour; and the wings are greyish black with a fringe of reddish brown; the legs and feet are red-brown. In the adult female the colour is similar, but not so glossy and lustrous as in the male, and the body is more spotted. The young birds are unspotted, uniform ash-brown above, clouded with white on the under surface. In the autumn the adults are somewhat lighter in colour, and lose the metallic lustre in some degree.

Pairing takes place early in the year, depending on the weather, and eggs are generally found in the first weeks of April. The starling builds without much care or art, in holes almost anywhere—in trees, eaves of buildings, church towers, caves, clefts, and rocks. It has also been observed to build openly in creeping plants against a wall, and in the thicker and uppermost branches of the spruce fir, the nest being placed close to the stem. In most cases, twigs, straw, hay, grass, moss, or wool are used to line the nest, but sometimes scarcely any lining is supplied. Four to seven eggs are laid (5 or 6 may be taken as the average number), these being pale blue in colour tinged with green, and very

slightly more than an inch long. There are often two broods in the season, and eggs are found from the beginning of April until the end of June.

Starlings have increased very markedly of late years. This is due partly to the protection which they enjoy, and partly to their power of rapidly moving from place to place according to the abundance or scarcity of food. They are strong and bold birds, and are not driven away from their nesting places by other birds, not even by the pugnacious, ubiquitous sparrow, which is fast exterminating swallows and house-martins.

Starlings almost invariably utilise holes for breeding, and they have, both in Belgium and Germany, been long supplied with artificial nesting-boxes where natural nesting-places are not available. A box 10 to 12 inches in depth, and 6 inches by 6 inches in cross section, with a sloping and slightly overhanging roof, and a hole near the top 2 to 2¼ inches in diameter, with a perch below, will not usually remain long tenantless. It is best fixed on the sheltered side of a tree or wall. If it be placed where it can easily be kept under observation, convincing proof will be furnished, when the young are being fed, of the capacity for the destruction of grubs possessed by this useful bird.

When the nights begin to get cold in autumn starlings congregate in large flocks, and frequent by preference moist marshy districts. They spread over fields and meadows in search of insects by day, and at night return to their roosting places, which may be shrubberies and plantations, or beds of reeds or osiers. The aerial evolutions preceding roosting in autumn have repeatedly excited the admiration of observers. According to Seebohm a large flock of starlings will divide into several parts as the night approaches, each going to a separate roosting place. He adds: "Starlings often congregate with rooks and jackdaws in the autumn on the pastures, and later in the year with redwings. When alarmed, the starlings, as if to a bird obeying a commander's voice, fly off in a compact mass, and if the danger soon passes, they will wheel and return again in the greatest order. The rooks and daws will scurry off in all directions, and the redwings will seek the nearest trees in a long straggling train, but the starlings seem to act under one common impulse."

In hard weather, and when food is scarce, the starlings migrate to Cornwall and Wales, the Western counties, and other parts of the country where frost is not so intense, but they ultimately return to their native places, and the same pairs occupy their accustomed nests.

Food of Starlings.

Insect Food.—The starling is of much benefit to agriculturists, as its food consists principally of worms, snails, and insects in their different stages. It is especially useful in

clearing off chafer larvæ, and other larvæ of the same habits, in meadows and pastures, and surface caterpillars in turnip and mangold fields. The destructive larvæ of the Antler moth, the Diamond Back moth, the Silvery Y moth, and of other moths, as well as those of the Daddy Longlegs, and of the Click Beetle (known as wire-worms), are also eagerly devoured by this bird. In the late autumn and winter, when the starlings congregate in flocks, they clear whole fields of injurious insects in larval or pupal form, and their sharp eyes detect the eggs of at least the larger insects upon forest and orchard trees. The insects that hibernate in the larval or pupal form upon fruit and other trees are, without doubt, picked out of their winter quarters by the long, pointed beaks of these sharp-eyed restless birds.

Some years ago, in a large and richly stocked nursery in Belgium, chafer beetles became so numerous as to be a very serious infestation. After trying by all known means to eradicate them, the proprietor observed that starlings devoured large numbers both of the larvæ and the mature insects. Taking a lesson from this, he erected about half-a-dozen nesting-boxes on 15-feet poles, and as these were immediately occupied by the birds he continued to provide boxes until 125 were in use. The result was that the chafer infestation grew gradually less and was finally completely overcome.

Sheep regard starlings as their natural friends, and permit them to alight on their backs to take out the keds, ticks, etc., from their wool. Some farmers, however, maintain that the droppings which starlings deposit on the backs of sheep attract flies, and that sheep are not infrequently "struck" by maggots exactly on the spot (the loins) where the birds most usually settle. In early summer it will often be found that cattle on pastures are accompanied by starlings, each animal being surrounded at a distance of a few feet by about half a dozen birds. Whether these are attracted by the worms that are apt to come to the surface of the ground when disturbed by the treading of cattle, or are on the look-out for the maggots of the warble-fly, which in spring and early summer drop from the backs of cattle, has not been definitely made out. Starlings may often be seen accompanying rooks in meadows and fields in a joint search for insects. In the summer a pair of starlings may often be seen in meadows and fields near their nesting place, surrounded by five or six young ones, busily engaged in hunting for insects. Broods frequently keep together until the autumn, when they join the flocks congregated for the winter. In the breeding season the quantity of insects consumed by starlings is enormous. A single starling has been seen to carry food to its young, from a grass paddock 100 yards distant from the nest, as many as eighteen times in fifteen minutes.

Vegetable Food.—During the year, 1904, many complaints were made of the depredations of starlings, not only in the Kentish cherry orchards, but in apple and pear orchards and in connection with other fruit. Wheat also has been frequently attacked, and in some districts fields of seed-wheat have apparently suffered heavily. In one or two instances when birds have been opened, the crops and gizzards have been found to contain whole and partly digested seed corn, whilst the birds have been seen at work in the field pulling up and devouring the sprouting grain. Indeed, many persons have come to consider the bird to be altered in character, owing to this partiality for vegetable food.

Mr. Froggatt, Government Entomologist for New South Wales, reports that in the neighbourhood of Melbourne the starling is the greatest pest with which gardeners have to deal, all fruit trees in the surburban gardens having to be covered with nets before the fruit is coloured. Some growers entirely lost their cherry crops by immense flocks of starlings, which are considered to be even more destructive than sparrows.

Summary.

On the one hand :—

1. The starling feeds principally on worms, snails, chafer larvæ, and beetles, wireworms, surface caterpillars, larvæ of Daddy Longlegs, and many other harmful insects, together with pupæ and eggs.

2. The starling is entirely useful on newly ploughed land, and in meadows and pastures.

On the other hand :—

The bird devours or spoils cherries, apples, and pears, and other fruit to a less extent, whilst it is sometimes destructive to seed-wheat.

There is no doubt that starlings do much harm in the orchards of this country when the fruit is ripening. On the whole, however, the information at present collected goes to show that, in view of their great partiality for insect food, starlings are, from the forest standpoint, entirely useful, whilst in agriculture and gardening their usefulness far more than outweighs the occasional harm done.

4, Whitehall Place, London, S.W.,
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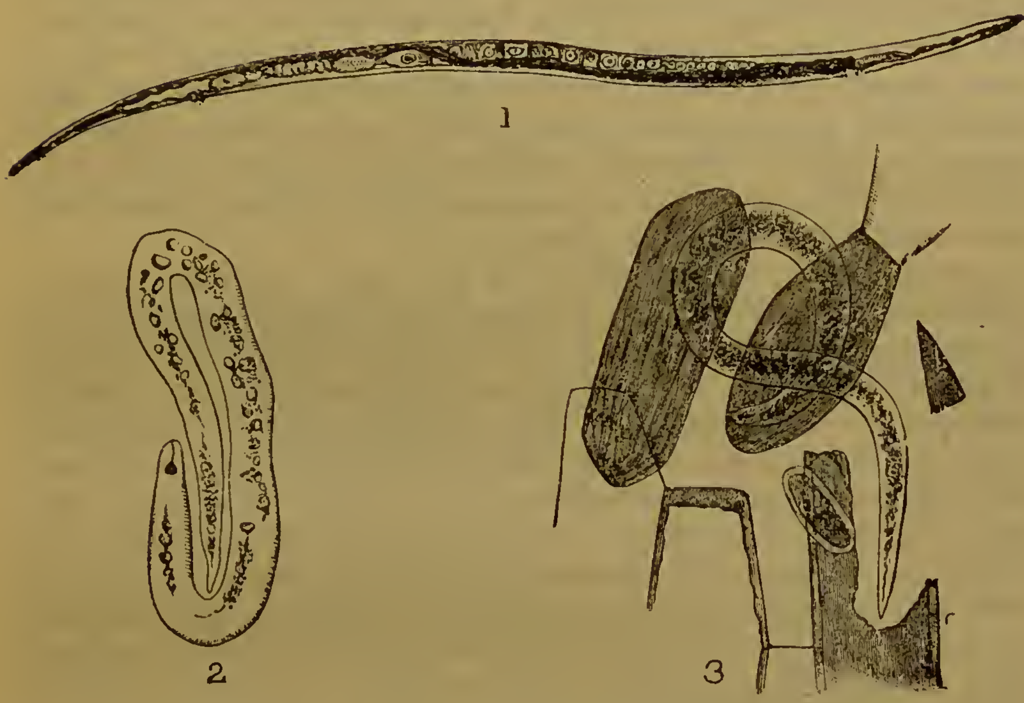
BOARD OF AGRICULTURE AND FISHERIES.

The Stem Eelworm (*Tylenchus devastatrix, Kühn*).



1. Eelworm. 2. Young form just emerged from egg.*
3. Eelworm and egg in plant tissues.
(1 much magnified, 2 and 3 more highly magnified.)

The mischief caused by the stem eelworm (*Tylenchus devastatrix*) appears to be extending. For some years past complaints have been received of the failure of various kinds of crops from some unperceived cause, which, on examination, proved to be the stem eelworm. Wheat, oats, hops, clover, and onions were the principal subjects of this infestation submitted for investigation, and in all cases eelworms of this species were found in the stems of the affected plants.

* These figures are reproduced from Dr. Ritzema Bos' *L'Anguillule de la Tige*, with his courteous permission.

As a rule, there were no signs of any insect or fungoid attack, except in some of the diseased clover plants, in which there were fungi present, together with the eelworms. In some specimens of diseased clover plants from large fields where disease was rampant, the stems of the affected plants were swarming with eelworms; there was also in the same plants injury caused by the action of the fungus *Sclerotinia trifoliorum* (Erik.). It was difficult to determine whether the *Tylenchus* or the fungus was the primary source of the injury to these clover plants. In some other plants examined, the cause of the disease was certainly *Sclerotinia*, as there were no eelworms present.

Among Leguminosae red clover is especially subject to infestation by these eelworms, but lucerne is also attacked. While the clover plants are small, and during winter when their growth is practically arrested, the eelworms get the upper hand of them, the result being one of the conditions generally called "clover sickness." In clover fields left down for two years, bare patches, which extend widely in the second year, are often seen.

Infestation of wheat plants is not very common, but it does sometimes occur, and causes harm, most frequently, in wheat sown in the spring. In bad cases densely matted stems swollen at the base are produced, many being bulbous, or "tulip-rooted." Upon stripping off the sheathing leaves the inner leaves are found to be in a flabby condition, and microscopical examination will show that they are swarming with eelworms. The sheathing leaves may have eelworms within their tissues, and their edges are probably curved outwards. Eelworms are also present in the bulbous stems, though not in such numbers as in the inner leaves. They materially damage the plants, and quite prevent the production of grain-bearing stems.

Oat plants frequently sustain serious injury from this eelworm. Their stems are short, yield little or no corn, and become "tulip-rooted." In a bad attack the roots become shortened, contorted, and light in colour, and are evidently of little use to the plants. The edges of the leaves are twisted outwards in a peculiar fashion.

Rye does not appear to suffer much in this country from this eelworm, though in France and Germany it is often seriously injured. Barley does not seem to be attacked.

Beans are occasionally infested, when the lower parts of the plants become swollen, and growth is stayed.

Onion plants infested by eelworms in the early stage of their growth have swollen and twisted leaves, in which eelworms may be found in large numbers. When the bulb is more advanced, it swells unnaturally in the upper part, and becomes soft and pulpy. It splits open, the outer folds fall away, and the whole bulb soon decays. In the growing

parts of the bulbs eelworms are found in numbers in all stages of existence, but not in the decayed parts.

Hyacinths and other flower bulbs are affected by this eelworm in the same manner as onions.

Some roots of hop plants which had become "nettleheaded," as hop-planters say, and of which the growth was arrested, —while the bines slipped down the poles and the leaves became distorted—were examined, and considerable numbers of *Tylenchus devastatrix* were found in them.

Some grasses and other wild plants are also infested by eelworms, amongst these being Yorkshire fog, sweet-scented vernal, annual meadow grass, daisy, shepherd's purse, spurrey, buttercup, cornflower, sow thistle, climbing buck-wheat, and lance-leaved plantain.

The roots of cucumbers and tomatoes are not infrequently found to be much swollen and covered with outgrowths, which are due to the attack of an eelworm, of, however, a different genus (*Heterodera radicicola*) to that at present under consideration, while *Heterodera schactii* infests beet, hops, and several crucifers.

Life History.

The full-grown eelworm (*Tylenchus devastatrix*) is about the twenty-fifth of an inch long. Its length varies somewhat in different plants. In appearance it resembles a tiny eel, with both ends pointed, the hind end specially so. It has a sharp spear-shaped point within the gullet (seen under a high magnification), which serves to pierce the tissues of plants and to extract their juices. The eggs are oval, and sometimes oblong in shape, as shown in the figure, and are found in the tissues of the host-plants, together with partly grown and fully developed eelworms. When the young worms come from the eggs, they are about one-seventh of the size of the adult eelworm, and resemble them in outward appearance, though their internal parts differ somewhat. The young form undergoes several changes or moults, before it becomes a perfect eelworm. When the tissues of the host-plant decay and dry up, the eelworms and the young forms either fall to the ground and enter it, or the eggs and young worms remain in the decaying and dead parts, and become dried up with them. Eggs containing the embryo worm can be kept dry for six months without losing their power of hatching, and young worms have the power of resuming animation and active life after they have remained in a perfectly dry condition, in dead tissues or in dry soil, for between two and three years. It is apparent that this faculty enormously increases the chances of the distribution and spread of this nematode, which may be carried into fields and gardens in this dried-up state with manure made from infested hay or straw—in these days cut very close to the ground.

Methods of Prevention and Remedy.

1. It may be said at once that this pest is extremely difficult to deal with, but the following points should be attended to. A rotation should be selected that will allow as long an interval as possible to elapse between the growth of two crops of the same species. Red clover, for instance, suffers severely on many farms if cultivated on the four-course rotation, whereas it remains comparatively healthy if the interval between two clover crops is extended to six or eight years. Onions also, in many cases, can only be successfully grown with a long interval between the crops.

2. As far as possible the refuse of infested crops should be destroyed. This may be most economically done by composting with lime.

3. Deep ploughing, with the use of a skim coulter, is an excellent preventive practice, not only against this pest, but also against many others, including insects and weeds. In garden cultivation trenching, so as to thoroughly bury the top spit, takes the place of deep ploughing.

4. Suitable manuring and cultivation, so as to produce vigorous plants, are general methods of prevention that no cultivator should neglect. Information with regard to certain points connected with manures will be found in Leaflet No. 72.

5. Several of the late Miss Ormerod's Annual Reports contain notes on eelworm infestation, and in the 1897 Report various dressings are quoted as having been useful, *e.g.*, "sulphate of potash at the rate of 1 cwt. per acre stopped disease in tulip-rooted oats." Again, in an experiment at Rothamsted on an eelworm infested clover field "a mixture of sulphate of potash 3 cwt., and sulphate of ammonia 1 cwt., per acre, was applied on April 3rd; the disease ceased and the clover made a very vigorous growth."

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BOARD OF AGRICULTURE AND FISHERIES.

The Asparagus Beetle (*Crioceris asparagi*).

1. Beetle enlarged ; 2. Beetle natural size ; 3. Eggs on plant (slightly enlarged) ; 4. Larvæ on asparagus.

[Reproduced, by permission, from the Journal of the South-Eastern Agricultural College, Wye, 1900, No. 9.]

This beetle now and then does harm to asparagus, especially in beds which have been established from one to

three years, by eating and disfiguring the heads as they are formed, but chiefly later on by attacking the stems, of which they are particularly fond. In the larval and beetle stages the insects bite the tender asparagus heads, making brown patches upon them, and cover them with a brown sticky fluid, emitted by the larvæ, defiling the heads also with masses of the sticky eggs, thus spoiling their appearance for market. Later on the beetles and larvæ eat the large round seeds, to which they are very partial. Plants may be completely bared of their foliage by a succession of broods of larvæ. The adult beetles now and then gnaw the shoots underground, and cause them to become bent and woody.

The Asparagus Beetle is locally common in the southern and eastern parts of England ; it is rarely found in the northern districts. Canon Fowler, in his Coleoptera of the British Isles, states that he does not know of a record from any locality farther north than South Derbyshire. Enquiries made in 1899 failed to show its presence in the North of England or in Scotland. It is fairly widely distributed around London, and has been recorded as doing damage in Gloucestershire and Warwickshire. It is common in parts of Kent, but rare in Dorsetshire and the western counties. It is known in France, Germany, and Italy, and probably throughout Europe.

Life History.

The beetle (Figs. 1 and 2) is one-fifth to a quarter of an inch long. It is slender and graceful in form. Its body is shiny black, with a blue tinge ; its head is black ; its antennæ are dark brown ; its thorax is red, with two or three black marks or lines upon it. The wing-cases have the outer margins of a pale yellow, and inner margins black, and there is a transverse bar of black across them ; upon each wing-case there are three yellowish or lemon-yellowish spots, or patches, which, with the transverse bar and the black margins, form the figure of a cross ; hence the beetle is termed "Cross-bearer." These markings are very variable ; sometimes the yellow spots are very small, at others very large.

Eggs (Fig. 3) are laid from June onward, first upon the heads and shoots, and later upon the feathery foliage of the asparagus plants. The eggs are brown to dusky greenish-brown, and oval, being glued by their ends to the plants, usually in rows of three to five, but frequently they are placed singly, and occasionally in rows up to eight in number. They are usually covered with a thin gummy coat, and are about one-sixteenth of an inch long. Larvæ come forth in from five to seven days, and immediately begin to feed upon the asparagus. Chittenden says the egg

stage lasts from three to eight days in America. The larval stage lasts ten to thirteen days. On reaching maturity, the larvæ fall to the earth and undergo transformation just beneath its surface in a slight cocoon. The number of broods appears to depend upon the weather; in some seasons there are three, in others only two broods. Beetles and larvæ are frequently found upon the plants until the middle of October.

The larva (Fig. 4) when full-fed is from two-fifths to nearly half an inch in length; in colour it varies from dirty greenish-grey to dull slate; the skin is wrinkled, and each segment is provided with a pair of fleshy foot-like tubercles, except the first three, which are each provided with a pair of jointed feet; the head is black, and the tail segment has a distinct proleg. The colour varies very much, some grubs being almost yellow. They hold very firmly to the plant by means of the tubercles and anal proleg. They probably moult their skin three times, although only two moults have been observed. As soon as they have buried themselves under the soil they form a cocoon composed of frothy saliva, which hardens into a case of parchment-like consistency of a dull yellow colour, which becomes covered externally with grains of earth.

According to Lintner, some larvæ merely "conceal themselves beneath dead leaves and other material on the surface."

The pupa is pale yellowish in colour. In Great Britain the pupal stage lasts from fourteen to twenty days. The beetle hatches some three or four days before it makes its appearance above ground, so that the actual pupal existence is shorter than it seems to be. The adults hibernate during winter. They have been found during the winter in the earth, under stones, sticks, and rubbish generally, also under the bark of trees and in hollow stalks.

Effect of Weather on the Eggs, Larvæ, and Adults.

In hot, dry weather many eggs shrivel up, and the larvæ often fail to reach maturity. But during warm weather the beetles breed more rapidly; nevertheless, a long period of hot, dry weather materially affects their increase. Very cold winters also affect the hibernating beetles, numbers apparently being killed, particularly if warm and cold spells of weather alternate.

Natural Enemies.

A few natural enemies help to keep down an excess of this beetle. The most important is the Two-spotted Lady Bird (*Adalia bipunctata*), whose larvæ ("niggers") devour the eggs of the beetle. The adults have also been observed

to eat them. Larvæ of the Lace Wing Flies (*Chrysopidæ*), which are such ravenous Green Fly eaters, also attack the larvæ of the Asparagus Beetle.

An Allied Species.

A closely-related species—the Twelve-spotted Asparagus Beetle (*Crioceris duodecim-punctata*, Linn.), is also found on asparagus in Europe and America, the larvæ living on the foliage and in the berries. In colour it is orange-red, each wing case having six round black spots. It is apparently very rare, if not extinct, in Great Britain. As it is more troublesome than the common Asparagus Beetle a look-out should be kept for it by growers in this country.

Methods of Prevention, and Remedies.

In the first stages of this attack, that is, when the beetles are feeding upon the juicy parts of the heads of the asparagus as they are formed, it is difficult to deal with them, though at this period they do considerable harm by making the heads brown and spotty. It is desirable to leave a few heads uncut in every bed where there is infestation as traps for the beetles, which get up the feathery shoots and branches during the day for pairing and the deposition of eggs. In the course of eight or nine days these plants should be cut off close to the ground, and burnt. Another set of heads should be allowed to run to shoots, which should also be similarly disposed of. In America a method among prominent growers is to cut down all asparagus plants in early spring so as to force the parent beetles to lay their eggs upon new shoots, which are then cut every few days before the eggs have time to hatch.

Beds of young asparagus plants are most liable to this attack in the first year or two, when only the strongest heads are cut for market, as the beetles like the succulent shoots of young plants. It would seriously injure the stocks in *newly-made* infested beds to cut off their shoots. In such cases, it would be better to handpick the beds, killing the grubs and eggs between the fingers. Very finely powdered lime dusted on infested plants would also be efficacious, as it would adhere to the slimy bodies of the larvæ. The lime should be applied as soon as the larvæ are noticed, and the application repeated at intervals. In extensive beds the remedies to be employed are liming and trapping, as indicated above, by letting some heads grow into plants and brushing them off and burning them. Syringing can be adopted in gardens. Where asparagus is grown upon a large scale this process is more difficult, as the plants are not set in rows, but it may

be effected by means of knapsack spraying machines. Paraffin emulsion, consisting of two gallons of paraffin oil and half a pound of soft soap dissolved in a gallon of soft water, may be used for spraying purposes. The soap should be boiled, and while boiling the paraffin should be poured into it and churned up with the soap until it is thoroughly incorporated. The mixture should then be diluted with fifteen to twenty gallons of soft water.

Paris green is also a valuable remedy against these and other insects which feed upon foliage. It may be used at the rate of one pound of Paris green to 200 gallons of water. 2 lbs. of fresh lime must be mixed with the Paris green. This mixture can also be put on with a knapsack machine. *As this is poisonous, it should not be used till the asparagus has all been cut.*

Spraying should be carried out before the foliage has become thick and strong. It may be necessary to repeat this operation, and it would be effective against both beetles and larvæ.

Poultry and ducks do not seem to eat asparagus, but they readily devour grubs; a few kept in the gardens, especially ducks, would probably do much good.

It would be desirable to examine the roots of asparagus obtained for making new beds, as the pupæ or beetles may be conveyed in these. In the United States infestation is extended partly in this way.

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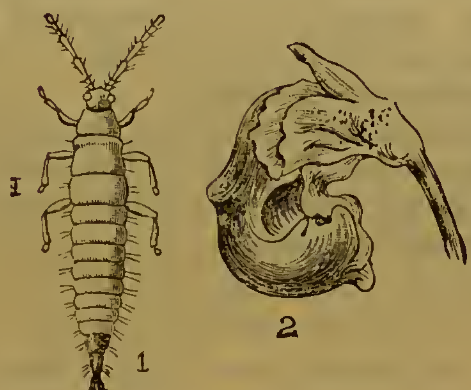
BOARD OF AGRICULTURE AND FISHERIES.

Pea and Bean Thrips, or Black Fly (*Thrips pisivora*).



1. Thrips, much magnified ; line showing natural size.
2. Distorted pod.

Complaints are sometimes made of the damage caused by the small insects, popularly called Black Fly Thrips or Thunder Fly, to peas and beans. In 1897 pea plants infested with a species of Thrips were sent to the Board from Kent. Both field and garden peas were attacked. In August 1900 scarlet-runner beans were seriously damaged by these insects in the neighbourhood of Crawley, Sussex. The species of Thrips attacking peas, beans, and other leguminous plants in this country is not definitely established. A great number of kinds exist, some attack wheat, others onions, others are serious pests under glass ; damage has been reported to apples ; others are carnivorous in habits. In their adult stage they have normally four narrow wings, more or less fringed all round ; specimens seldom reach more than $\frac{1}{10}$ of an inch in length. The mouth is formed partly for biting and partly for suction. The six legs are very short, and end in a bladder-like expansion with hooks at the side. Like the Plant Lice they undergo an incomplete metamorphosis ; that is, there is no quiescent chrysalis stage.

Damage caused by Thrips.

In the case of attack on leguminous plants, the damage is done almost entirely to the blossom ; the pods are thus checked in development. The haulm in cases reported has always been fully developed, but flowers and perfect pods were practically all destroyed. The 'black-fly' by sucking away the sap of the delicate blossoms causes the petals to shrivel up, and the flowers eventually fall off, leaving the stalks behind. In both the attack on peas, reported to the Board, and that on scarlet-runner beans in Sussex, an occasional pod developed, always stunted, however, and more or less distorted and discoloured by the punctures of the Thrips. The plants in both cases looked perfectly healthy and had a good show of blossom promising a good yield, but were practically all destroyed by these insects, which, although insignificant in size, are capable of doing an immense amount of mischief.

In the attack on beans it was noticed that the lower petals of the blossoms were the first to show signs of shrivelling up, then the upper gradually died away, until a little shrivelled mass only remained.

Description and Life History.

The Thrips may be found in all stages inside the blossoms. The adult female is about $\frac{1}{16}$th to $\frac{1}{12}$th of an inch long, deep blackish-brown with paler head and six rather paler bands on the abdomen. There are four narrow wings which are folded over the abdomen in repose ; these are densely edged with fine hairs. The antennæ are yellowish-brown with the two basal joints deep brown. The females appear in spring, and like most Thripidæ seem to feed on a variety of plants. As soon as the peas or beans come to the flowering stage the females lay their eggs in the folds of the unopened blossoms. The small eggs may be found loose in the flowers, and hatch out in from eight to ten days. The larvæ are orange in hue, without any traces of wings, and are very active. The larval stage apparently lasts from three to four weeks. The nymph is very similar to the larva in form, but is much paler in hue and shows traces of the wings, in the form of wing-buds. This stage lasts from five to ten days. One or more generations may occur amongst the Thripidæ in the year. No males could be detected amongst those attacking the beans. In all recent cases of Thrips on Leguminosæ the females have been winged, and no males have been observed. In most Thrips the females are winged and the males may be winged or wingless.

The winter is passed in the adult stage, the insects hibernating under the rough bark of trees, in crevices and under any rough bark on the pea and bean sticks, as also amongst the rough herbage at the foot of hedgerows, etc., from whence they come out in the spring and feed on the leaves of various plants.

Prevention and Remedies.

As far as possible all likely winter shelter should be destroyed. Old sticks used for scarlet-runner beans or peas are sure to harbour Thrips. They, and the haulm, should be burnt as soon as possible when the crop is seen to be irreparably damaged. It would certainly be advisable not to grow peas or beans the following year anywhere near where the infested crop had been. Spraying might do some good, but in the case of blossom attacks is a doubtful method. For leaf-destroying Thrips there is nothing like *pyrethrum* wash, formed by adding 1 ounce of fresh *pyrethrum* to 2 gallons of soft water and an ounce of soft soap. In garden cultivation this might be tried as an experiment for this particular species. Liming the ground, and destroying their shelter by burning sticks and haulm as soon as possible, seems all that can be done on a large scale.

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BOARD OF AGRICULTURE AND FISHERIES.

The Fruit Tree Beetle (*Scolytus rugulosus*, Ratzeburg).

1. Beetle magnified; line showing natural length.
2. Larva, natural size, and much magnified.
3. Piece of Apple branch, showing holes in bark made by the beetle, and channels made in the wood.

Complaints are often received of injuries to apple, plum, and other fruit trees, which prove to be caused by the boring beetles known as *Scolytus rugulosus*. This is one of a group of bark-boring beetles whose characteristic it is for the beetles to bore bodily into the bark, below which the female makes a gallery or tunnel, the so-called "mother tunnel."

Description of Beetle.

The beetle is barely one-tenth of an inch long, and black in colour, except the ends of the wing-covers, legs, and the clubbed antennæ, which are of a russet hue. The thorax and wing-covers are much wrinkled and punctated. The larva or grub is not quite one-tenth of an inch long when extended, it is milky white, without legs, and has a yellowish head furnished with strong brown mandibles. The upper part of the body is considerably thicker than the lower part, and it lies in a curved position. The pupa is also white.

Plants attacked and how damaged.

Plum, apple, pear, cherry, bird cherry, apricot, nectarine, peach, quince, mountain ash, hawthorn, *i.e.*, trees, and especially fruit trees, belonging to the natural order *Rosaceae.*

The damage is done by the beetle and the grub boring between the bark and the wood interfering with the conduction of sap ; the final result of bad infestation is the withering away and death of the attacked branches and plants. Thick and thin branches are both attacked.

Life History.

The beetles bore into the bark, and after pairing the female proceeds to gnaw out her perpendicular tunnel. These "mother tunnels" are short, measuring from $\frac{5}{8}$ inch to about $1\frac{1}{4}$ inch in length. Along both sides of this gallery the female lays eggs ; the grubs on hatching from these begin to eat out their tunnels at right angles to the "mother tunnel." The larval tunnels are slightly wavy, but their regularity depends to some extent on whether there is an overcrowding by the tunnels of adjacent broods. Great crowding is very characteristic of the *rugulosus* attack, the result being that the loosened bark can very easily be peeled away. When full grown, each grub excavates a little hollow, or bed, at the end of its burrow, and here, covered by the saw-dust or bore-meal, the pupa stage is passed. If the bark of the attacked part be somewhat thick, the galleries may show more in the bark ; if the bark be thinner, then the outermost youngest layer of the wood shows the tunnels cut into it, including the pupal bed. The pupa gradually darkens in colour and passes into the beetle, which ultimately bores through bed cover and bark, the exit or flight holes showing plainly, as if the bark had been riddled by fine shot.

There is difference of opinion as to the number of generations in a year, but probably, as has been proved with other beetles, *Scolytus rugulosus* is to be found at work during suitable weather from April right on till the autumn. The beetles are found flying first of all in April and May, and a new generation of beetles from the eggs of these may begin to come away in June and July.

Preventive and Remedial Measures.

1. Pruning, and removing and burning sickly branches and trees, as these are chosen by the beetles for their egg-laying.

2. The application of noxious compositions is quite useless as a means of preventing the beetles from boring into trees, unless all the trees in an orchard or fruit plantation are similarly treated, which would be a difficult and costly process. When the beetles have once got into the bark no amount of syringing will affect them. In the case of gardens with two or three trees only, these might be daubed over with a very thick wash of an offensive nature, such as thick paraffin emulsion, before the leaves and buds showed, so as to prevent egg-laying where an attack is feared. Dr. W. Saunders, of the Dominion Experimental Farm, Ottawa, recommends soft soap reduced to the consistency of thick paint by the addition of a strong solution of washing soda in water, applied to the bark of the tree especially about the base or collar, and extending up to the point where the main branches have their origin. If this is applied during the morning of a warm day, it will harden and form a coat not easily dissolved by rain. But this pest also attacks the small boughs, so that this method can scarcely be really effective.

3. Where the beetles have got to work the infested plants or branches should be treated for a time as traps, or sickly trees can be allowed to remain as material which the beetles will choose for egg laying. All such traps should be burned, the first burning to take place not later than the end of May. No tree should be allowed to stand and no trap allowed to remain for more than six weeks after being attacked, or otherwise it will become a centre for distribution of the insects.

4. The grubs of *rugulosus* are preyed upon to some extent by birds and parasitic Hymenoptera.

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BOARD OF AGRICULTURE AND FISHERIES.

Water Wagtails, or "Dish-washers."

(*Motacillæ.*)

There are five species of Wagtails found in this country. Of these only three are fairly common—the Pied Wagtail (*Motacilla lugubris*), the Grey Wagtail (*Motacilla melanope*), and the Yellow Wagtail (*Motacilla campestris*). The other two, the White Wagtail (*Motacilla alba*) and the Blue-headed Wagtail (*Motacilla flava*), are comparatively rare in Great Britain. Few species of birds are more useful—within the limits of their numbers—than Wagtails, because their food is for the most part of a "soft" character, comprising insects of all kinds and in all stages. For this reason alone, apart from their harmlessness to crops and their beauty, they, and their eggs, deserve to be protected. They do not figure in the original schedules of the Wild Birds' Protection Act of 1880; but in several counties in England, Wales, and Scotland some of the species have been added to the schedule. The eggs are protected, under the Act of 1894, in a few English counties.

The Pied Wagtail (*see* Fig.) is perhaps the most common of the Wagtails, and may generally be seen in meadows, pastures and fields where cattle and sheep are grazing, busily engaged in catching the insects attracted by these animals. Gilbert White says: "Wagtails run round cattle, availing themselves of the flies that settle on their legs, and probably finding worms and larvæ roused by the trampling of their feet." "Interest," he adds, "makes strange friendships." This bird is also seen near ponds, streams and rivers, and in marshes and flooded meadows, taking the insects found there. If Pied Wagtails are watched, it will be seen that they are never still, but are continually hunting for insects of all descriptions: beetles, flies, moths, and aphides, as well as millipedes, snails and slugs.

The Pied Wagtails migrate from the more northern to the southern parts of the kingdom in the autumn, and some leave this country for the winter. Flocks of them have been noticed in Kent and Sussex near the coast in September, evidently bound for foreign climes. These return again very early in the spring, but there are always Pied Wagtails to be seen throughout the winter in this country, except in the more northern regions.

The male of this species of Wagtail is rather more than 7 inches in length, the female is slightly over 6 inches long, from beak to tip of tail. The body is black above, while the breast, belly, and parts under the tail are white. There are also white feathers on the margins of the wings and tail, but the legs and beak are black. The throat is black in summer, but becomes white in winter. Breeding begins in the spring, and there are often two broods in the season. The nest is constructed of moss, dried grass, bents, and fine roots, and lined with wool, feathers, and other soft materials. From four to six eggs are laid, of which the ground colour is bluish white, with brownish or purple-brown specks.

The Grey Wagtail (*Motacilla melanope*) is not such an abundant species as the Pied Wagtail. It is of more solitary habits, and is found chiefly in the mountainous and hilly districts of England and Scotland. It breeds, however, frequently in Devon, Dorset, Somerset, and Wilts, and in localities generally where there are streams and brooks, and plenty of water; but less frequently in the south-eastern districts. It is fairly common in Ireland. It migrates to the more southern counties in the autumn. Like the Wagtail first described, this species subsists entirely upon insects, and may be seen, especially near brooks and other water-courses and in marshes, busily hunting for its food. It is particularly addicted to small snails—fresh-water molluscs—and this predilection probably enables it to do good service to sheep farmers and breeders by destroying quantities of the snail known as *Limnœa truncatula*, which is the host of that scourge of flocks the liver-fluke (*Distoma hepaticum*). Species of *Limnœa* have been found in the crops of all the three Wagtails commonly met with. It was not actually ascertained that the snails were *Limnœa truncatula*, but there can be no doubt that if these birds feed upon one species of *Limnœa*, they would also feed upon *Limnœa truncatula*, a small thin-shelled snail coming from water-courses and wet ditches to marsh pastures and low-lying grass-land.

The Grey Wagtail is not quite so large as the Pied Wagtail. In colour it is blue-grey or slate, with a line of white above the eyes. In summer it has a black chin and throat; the breast, belly, and underside of the tail are yellow; the beak and feet are black. Yellow is such a prominent colour in the Grey Wagtail that its name scarcely seems appropriate, and it is, on this account, apt to be confused with the next species. It builds early in the spring, generally in banks, a nest lined with hair, much like that of the Pied Wagtail, and lays five eggs as a rule, though sometimes as many as seven have been seen. The eggs are of a creamy white colour, speckled with light brown blotches, and marked with a few black hair streaks.

The Yellow Wagtail (*Motacilla campestris*) is not a winter resident in this country, but appears in April, and leaves in September and October. It is distributed throughout England generally, but is not common in Scotland, except

THE PIED WAGTAIL.

in the more southern counties, whilst in Ireland it is rarely seen. On the first arrival of the immigrants they are found in marshes and grass land, but soon pair and go to the cultivated fields, where they may be seen hunting for insects

and following the plough with assiduity, swallowing millipedes, wireworms, and other insects as they are turned up. Breeding begins early, and after the young are hatched, the birds move off to meadows, marshes, and pastures, where they follow cattle and sheep for the insects around them, and may be seen busily hunting for all kinds of insects, upon which they live. Like all the Wagtails or Dish-washers, they are constantly found near water-courses, ponds, and marshy places. There is no doubt that this Wagtail, like its congeners, devours the snail-hosts of the liver-fluke.

The Yellow Wagtail, as its name implies, is mainly of a yellow or canary colour. The upper parts of the bird are olive, or greenish yellow, and the lower parts more of a canary yellow. The plumage of the female is not so bright as that of the male; the bill and feet are black. In length it is about 6½ inches. From four to six eggs are laid; they are greyish-white, mottled with clay-brown, with a few black hair streaks. The nest, usually on the ground in grass or tufts, and occasionally on a bank, is composed of dried bents and fine roots, with dried grass and wool, or hair, or even fine roots, for a lining. Nests are sometimes found upon ploughed land. Two broods are sometimes produced in a season.

4, Whitehall Place, S.W.
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BOARD OF AGRICULTURE AND FISHERIES.

The Barn Owl (*Strix flammea*).

The Barn, White, Screech, or Church Owl, as it has been variously called, is beyond question a most useful bird, and yet it has been much persecuted.

The destruction of this bird has been due to a variety of reasons : to superstition (associated with the bird's being a night flier, and having a noiseless flight and a weird cry) ; to faulty observation and ignorance of its true food habits ; to the price obtainable for its eggs ; to the demand for the bird by bird-stuffers ; and to the use of its plumage for decorative purposes.

There is some ground for the belief that even with gamekeepers the Barn Owl is not so ruthlessly destroyed as formerly, the statement that the chief food of the owl consisted of game birds having been disproved. The Barn Owl (like other birds of prey) has the habit of disgorging by way of the mouth indigestible particles, in the form of pellets, and by examination of these one can determine on what the bird has been feeding. Dissection and examination by competent and unprejudiced observers of numbers of the disgorged pellets, has proved that fur and not feather is the chief food.

Description.

The Barn Owl has the characteristic curved beak and strong talons of a bird of prey. The colour varies in different specimens ; the upper parts of the adult may be tawny-buff, mottled with grey and white and brown, and the under surface whitish. The upper side may, however, be more grey than brown, and the under side yellowish with greyish or blackish spots.

The face is white and the bill yellow. Round the eyes and beak the feathers show a heart-shaped pattern. The legs are long and covered with downy feathers. No tufts are present on the head, such as characterise the Long Eared and the Short Eared Owls. The female is rather larger than the male, the length being about 14 inches.

Favourite places for egg-laying are buildings, such as church towers, ruins, or barns, but holes in rocks, and hollow trees in woods are also used. Dovecotes may also be frequented, the owls living on the whole peacefully with the

pigeons. No actual nest is made. The eggs are white, and the number laid may be up to six or seven. Incubation begins, however, after, say, two have been laid, other eggs being laid at different periods during incubation, so that it is possible to find in the nesting place unhatched eggs and young of different ages.

The Barn Owl has a wide distribution.

Mode of Life and Food Habits.

During the day the owl stands motionless and asleep in its shelter-place, but at nightfall it sallies out with its stealthy noiseless flight and patrols its beat in the search for food. With its large eyes forwardly directed, the owl's sense of sight during flight is very keen (it cannot, however, see in perfect darkness), but it is equalled if not excelled by its sense of hearing. The ears are covered by folds of skin which are bent forwards during flight. The soft loose plumage enables the bird to fly along noiselessly so that the prey is not alarmed, while the slightest sound or motion of the prey is heard in the stillness, by the owl. The cry of the owl is a weird screech or shriek, and both old birds and owlets make a noise resembling snoring.

The food of the Barn Owl consists chiefly of mice and voles, but rats may be taken and also bats ; the larger insects are taken on occasion and even various small birds, but the percentage of these last is small ; the Barn Owl has been known also to take surface-swimming fish.

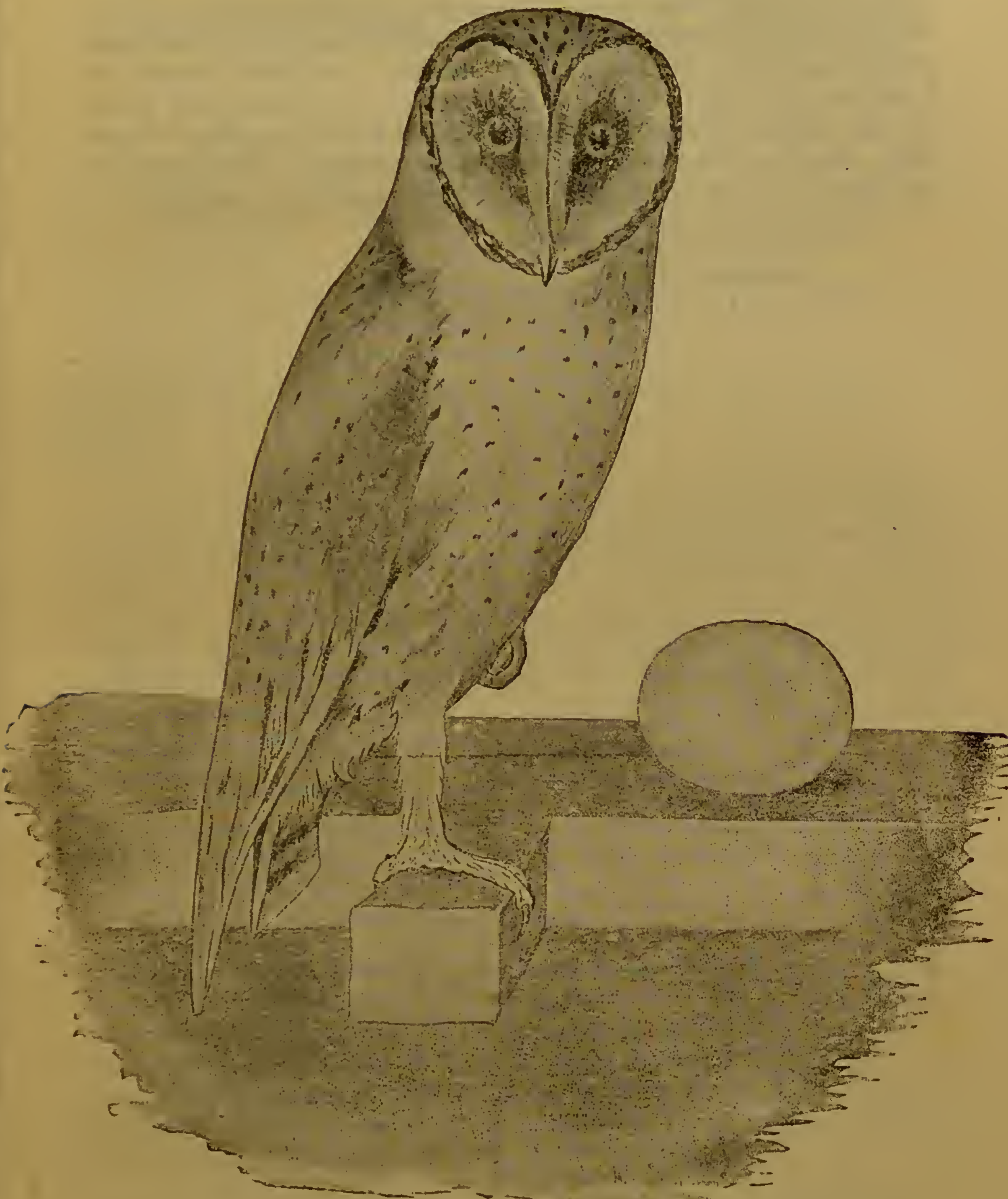
Seebohm, in his exhaustive history of British birds, holds that the Barn Owl is undoubtedly the farmer's best friend. He gives an instance in which twenty freshly-killed rats were found in a Barn Owl's nest. He also says that in 700 "pellets" of this owl there were found the remains of sixteen bats, 2,513 mice, one mole, and 22 birds of which nineteen were sparrows.

Lord Lilford writes of a half-grown owl eating nine mice in rapid succession and being hungry again in three hours ; and also of an old pair of owls which brought food to their nest seventeen times in half-an-hour.

Another obesrver describing the contents of various nesting places of the Barn Owl remarks that he found four species of mice at the same time in one nest : the common farm mouse ; the little white-bellied, red-backed, short-bodied, harvest mouse ; the large, thick-coated, full-headed, short-tailed grass mouse ; and the long, sandy, long-tailed long-eared field mouse.

The Barn Owl will take young hand-reared game birds, but this can easily be prevented by keeping them in their coops at night ; naturally hatched ones are safe under the mother's wings at night.

In the Report of the Departmental Committee of the Board of Agriculture on Field Voles in 1893 it is stated that white and brown owls prey upon these pests, which caused much mischief on hill farms in Scotland; and in



THE BARN OWL (*Strix flammea*), AND EGG.
(Owl ¼th, Egg ⅔rds natural size.)

their two schedules of the natural enemies of the vole the Committee place in the first category of "Vole-killers, harmless or nearly so to sheep, crops, and game," owls of all sorts, buzzards, kestrels, and the smaller seagulls.

In view of the unanimity of evidence as to the great utility of the Barn Owl, from witnesses who have carefully studied its habits, the necessity for the careful preservation of this valuable bird cannot be too strongly urged upon the whole rural community.

The White or Barn Owl is included in the Schedule of the Wild Birds' Protection Act, 1880, which provides that any person taking or killing an Owl during the close season is liable to a penalty of £1. The close season is generally from the 1st March to the 31st July; but in some counties it lasts from the 1st February to the 31st August. The eggs of the Barn Owl are protected in a large number of counties.

4, Whitehall Place, S.W.,
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BOARD OF AGRICULTURE AND FISHERIES.

Gooseberry Mildew (*Microsphaeria grossulariae.*)

During certain seasons when a warm moist spell of spring weather is followed by a sudden lowering of the temperature, the leaves of gooseberry bushes become more or less covered on both sides with delicate white patches of mildew which soon appear powdery as if sprinkled with flour.

The fine powder consists of myriads of spores of the summer form of fruit of the fungus, which unless destroyed are blown about by wind and infect neighbouring bushes.

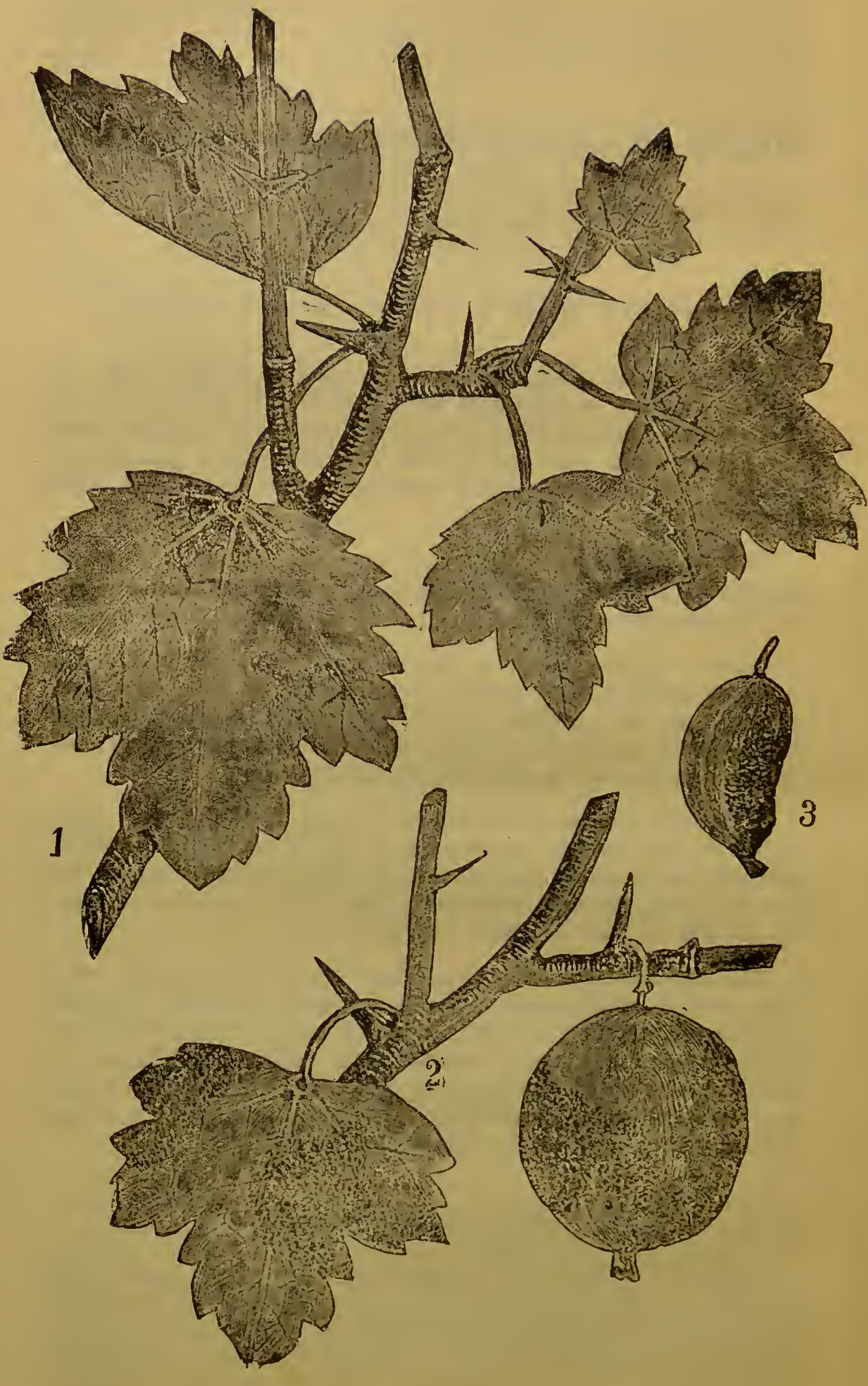
Later on in the season a second form of fruit under the form of minute black points, just visible to the naked eye, appears on the mildewed patches. This second form of fruit ripens on the dead fallen leaves during the winter, and infects the young leaves the following spring.

When the disease is severe the leaves die and fall quite early in the season, consequently the fruit is checked in growth and remains small, and if the epidemic occurs for two or three years in succession the bush becomes stunted in growth or may be killed outright.

The American gooseberry mildew (*Sphærotheca Mors-uvæ*), met with in considerable abundance in Co. Antrim, Ireland, during the summer of 1900, is much more destructive than its European ally, as it attacks both foliage and fruit. It first appears under the form of delicate white patches which gradually become thick and felty and change to a dingy brown colour and can be scraped off in flakes.

Prevention and Remedies.

Repeated experiments extending over many years have clearly proved that spraying with a solution of potassium sulphide, in the proportion of $1\frac{1}{2}$ lbs. of sulphide to 50 gallons of water, is the most effective remedy that can be applied. When the disease has previously existed the first spraying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should be done when the leaf-buds are expanding, and continued at intervals of ten days or a fortnight as occasion demands.

Bordeaux mixture must not be used after the fruit is set, and is not under any circumstances as effective as the potassium sulphide solution.

All dead fallen leaves should be collected and burned during the winter, and the ground under and around the bushes should be dug so as to bury any stray fungus fruit lying on the ground.

Description of the Figures.

1. Gooseberry Mildew.

2 & 3. American Gooseberry Mildew.

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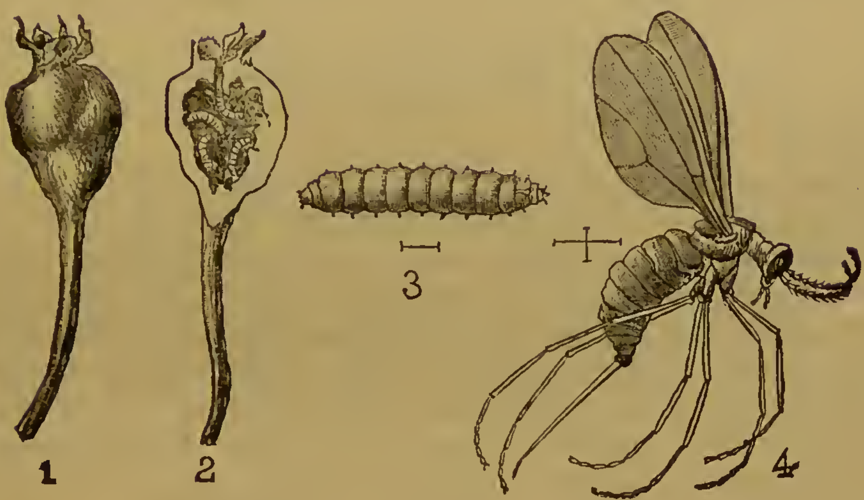
23795 Q

BOARD OF AGRICULTURE AND FISHERIES.

The Pear Midge.

(*Diplosis pyrivora.*)



1. Pear stunted and malformed by the larvæ within it. 2. Section of pear with larvæ. 3. Larva, much magnified. 4. Female fly, much magnified. Lines show natural length of fly and larva.

The pear midge causes serious losses in pear orchards by its attacks on the young fruit. Some pear growers, seeing the young pears falling fast in June when they are about the size of marbles, used to believe that this result was due to an unhealthy condition of the tree, or to influences of the weather, but they now recognise that it is more often due to the insidious attack of the tiny pear midge, the presence of which is far more common than is usually believed.

It would appear that early pears, and those that blossom early, are most liable to infestation by this insect. Williams' Bon Chrétien is notoriously subject to it, and in America, where the pear midge is very prevalent and most destructive, the Bartlett pear (identical with Williams' Bon Chrétien) and the Lawrence are the varieties chiefly attacked. Beurré de l'Assomption, earlier than Williams' Bon Chrétien, is also frequently seriously affected. Pitmaston Duchesse, Marie Louise, Jargonelle, Souvenir du Congrès, all early,

and like the Bon Chrétien in many respects, are also especially liable to be infested. Infestation has been noticed on later pears, as Josephine de Malines and Catillac, but in a much less degree than on earlier varieties.

Professor Riley, writing in 1885, considered that the insect had been imported from Europe, as until it was found in 1880 upon a certain farm near Meriden, in Connecticut, no insect of similar habits was found in the United States.

This is probably the same insect as that termed *Cecidomyia nigra* by Meigen. Schmidberger first described the habits of this insect in 1831. He says: "The species of gall-midges found by me in the pears are evidently the *Cecidomyia nigra*, because the description which Meigen gives of the black gall-midge completely agrees with this. I retain Meigen's name, and call it the black gall-midge." Riley, however, suggested that the name of *Diplosis pyrivora* would be suitable, and this has been adopted by entomologists, as it is not certain that Meigen's species is the same.

It is not known how long the pear midge has been at work in this country. It was first mentioned more than twenty-five years ago, and there is every reason to believe that it had been present here long before this, for its action upon pears, closely resembling, as it does, that of weather and other natural causes, might easily have been mistaken for these, especially as there were then comparatively few trained observers. It is certainly on the increase in many parts of the country, causing a heavy annual loss, and unless checked will cripple the cultivation of this fruit.

Description.

The fly is nearly one-tenth of an inch long, with an expanse of wings of nearly one-fifth of an inch. Its slender body is blackish-grey to black in colour, with pale yellowish and white hairs; its antennæ, with twenty-six joints in the male, are dark brown and very long; its legs are also very long, and yellowish brown. The wings are grey with dusky hairs, and a few dull yellowish ones at the base. The female is slightly longer than the male, having antennæ with fourteen joints, and an exceedingly long ovipositor for the purpose of depositing her eggs in the calyces of the blossoms of the pears. In colour the female is dusky grey, always paler than the male.

The larvæ are footless, yellowish-white in colour, and are composed of fourteen segments, with a brown head, bearing two nipple-like, two-jointed antennæ; on the underside near the head end is a long brown process slightly furcate at the tip—the anchor process or breast bone. When mature the larvæ reach one-seventh to one-sixth of an inch in length.

The pupa is about one-tenth of an inch in length, black above, and yellowish-brown beneath.

The eggs are longish, and transparent white, a number being laid in a single flower.

Life History.

The perfect midge appears in April, about the time the blossoms commence to show signs of the white petals, and continues on the wing until about the second week in May. The exact time varies from year to year and in different localities to some slight extent. The females lay their eggs both in the unopened and the expanded blossoms by means of the long egg-laying tube. When the blossom is unopened they pierce the petals and deposit the eggs on the anthers, usually in little heaps. When the blossoms are expanded they push the egg-tube deep into the pistil or ovary. In from four to six days the eggs hatch and the young maggots make their way into the developing fruit. By the first week in June some of the maggots are fully grown and commence to leave the fruit; the majority may be mature by the end of the second week, or towards the end of June the pears may still contain the maggots. Some are however unable to escape owing to the pears not splitting or decaying so rapidly, and thus remain on the trees longer. The majority of the maggots leave the pears, either by a cleft on the fruit or by some decayed patch. The fruit may or may not fall with the maggots in it; as a rule the larvæ escape when the pears are on the trees, but some correspondents mention the ground being covered with small fruit laden with midge larvæ. The maggots, in common with others of the genus *Diplosis*, have the power of skipping. When they leave the fruit on the trees they move to the outer surface, bend their bodies and make a spring on to the ground. At times this jumping habit is very marked. As many as forty larvæ have been counted in a single pear, but fifteen to twenty seems to be about the normal number. In some pears picked at random from infested material the following numbers were found :—16, 21, 28, 15, 19, 15, 17, 23. On reaching the ground the larvæ bury themselves under the soil, usually about an inch and a-half from the surface. Professor Lintner observed them to go as deep as two and a-half inches in America. At the end of about two weeks they have completed little papery cocoons of a dirty creamy silk, which become more or less covered with fine grains of earth. The cocoons are one-tenth of an inch long. Many of the maggots may remain as such until the end of winter and pupate in the early spring; others seem to pupate in a few weeks after entering the soil. If the larvæ cannot escape from the pear, as sometimes happens, they remain in it (as larvæ) for some time, until it decays on the ground.

When the larvæ first attack the fruitlets their presence cannot be detected ; later they form small dark tunnels, and by degrees they hollow out all the pear, which becomes internally a blackened mass of pulp and excreta.

Appearance of Infested Fruit.

About two weeks after the attack has commenced the fruitlets begin to swell abnormally. The diseased fruit always grows much more rapidly than the sound. By degrees the fruitlets become deformed, some rounded, others bulged out at the sides and much distorted. On cutting them open they will be found to contain the larvæ. Internal examination should always be made, as sometimes pears become deformed from other causes.

Preventive Measures.

1.—In gardens the best remedy is hand-picking where dwarf trees are attacked, but in large orchards this is not possible.

2.—Mr. Fletcher, entomologist to the Canadian Government, suggested that when trees are persistently badly attacked and the fruit not likely to come to maturity, a heavy spraying with arsenites or sulphate of copper should be given so as to kill the fruit ; the larvæ would thus all be starved to death by having their food destroyed.

3.—Skimming off two inches of the surface soil beneath the trees in winter and burning it, replacing it afterwards as is done in gooseberry sawfly attack, would be sure to do good, but on a large scale probably could not be carried out. Certainly it is advisable to cultivate the ground beneath the trees, instead of having the land under grass.

4.—At present no detailed experiments have been carried out with spraying, but it is possible that by spraying with paraffin emulsion as soon as the blossoms show the first white petals, and at the same time giving the ground a good drenching with the emulsion beneath the trees, the pest might be deterred from egg laying and many killed in the soil. This would have to be done at the time when the flies are appearing from the soil. The emulsion for the ground should of course be stronger than that applied to the tree.

5.—The use of kainit has proved serviceable in America. Dr. Smith, who has made careful experiments with the pear midge, has found that kainit spread under the trees has been most effectual in killing the larvæ. He recommends that the ground under the trees should be dressed with kainit at the rate of a ton to the acre and mentions an instance of an orchard so treated having practically escaped infestation, while in an adjoining orchard not treated he failed to find a single fruitlet not containing larvæ. In New Brunswick

kainit has also been used with success in orchards at the rate of half a ton to the acre. In Great Britain some experiments (Journal S.E. Agri. Coll., No. 7., p. 27) have shown that kainit at the rate of 5 cwt. to the acre killed the larvæ if applied just about the time the larvæ fall from the fruit, though a Herefordshire grower who employed this method in his orchards got negative results. It is certainly advisable for growers to give kainit a fair trial at the rate of half a ton to the acre, a quantity that may be safely used, where the orchards are down with grass or not cultivated with strawberries or vegetables. To be successful the kainit must be spread very evenly, and be applied just before or when the larvæ are falling, as it has the greatest effect on the larvæ before they become enshrouded in their silken cocoons.

6.—Gas lime has been used but is not successful; its coarse nature enables many of the grubs to escape its effects, but possibly, if finely powdered and spread evenly, it might have a similar effect to kainit.

4, Whitehall Place, S.W.
October, 1898.
Revised, July, 1905.

BOARD OF AGRICULTURE AND FISHERIES.

The Spotted Flycatcher.

(*Muscicapa grisola. Linn.*)

The spotted Flycatcher, known also in some districts as the "Beam bird" because it sometimes builds its nest on beams in outbuildings, is, as its name signifies, a devourer of insects. It is also known in Northamptonshire as the "Cobweb," and in Kent as the "Cherry sucker." It is a fairly common bird in England and some parts of Ireland, but is not so frequently met with in Scotland. It arrives in this country at the beginning of May, Gilbert White dating its arrival between May 10th and May 30th, although Markwick in his calendar gives the dates between the 25th of April and May 22nd. Other naturalists say that it generally appears when the oak is in leaf, which means that the date of its arrival in May depends upon whether the season is backward or forward. Selby says it seldom makes its appearance before the latter part of May, or until the woods are in complete foliage, when the particular insects that compose its food are in full vigour and maturity. Howard Saunders states that it has been observed exceptionally in our eastern counties as early as April 23rd. In Gilbert White's calendar the bird is recorded as departing from these shores between September 6th and September 29th, and these dates agree pretty closely with those given by Markwick and other observers.

The spotted Flycatcher frequents orchards, gardens, plantations and woods, and the banks of streams. It feeds exclusively upon insects, though it has been accused of eating fruit by those who have seen it near cherries and raspberries when in search of insects attracted by ripening fruit. Yarrell states that no remains of fruit were found in the stomachs of Flycatchers which had been suspected of taking fruit, and killed. Selby also observes that he has not been able to verify the alleged fondness of this bird for cherries, and he is inclined to believe that the Garden Warbler, sometimes called the greater Pettichaps (*Sylvia hortensis*) has in most cases been mistaken for the Flycatcher. The Garden Warbler does eat fruit, but there is not the least evidence of the spotted Flycatcher touching cherries or any other fruit, as it is sometimes supposed to do in Kent.

The spotted Flycatcher may often be seen either taking a short sharp flight in search of insects, or, perched on a rail, gate, or branch, making frequent swoops at passing

insects and returning to its coign of vantage. Sometimes it half jumps, half flutters, from the ground and snaps up flies, gnats, and other insects within easy reach. It takes all kinds of insects : moths, flies, beetles, and aphides. During August when the air is thick with aphides coming in swarms from the hop gardens, the Flycatchers appear to be perpetually in motion from their eagerness to devour the winged hosts. Macgillivray says that the food of this bird consists exclusively of insects of various kinds. He gives a description of the feeding of their young by a pair of Flycatchers. The parent birds brought food to the nest five hundred and thirty-seven times during the course of a day. "Their motions," Macgillivray says, "were so uncommonly rapid that I could not for a single moment keep my eye off the nest. By short jerks they usually caught the winged insects. It is impossible to give the precise number of flies that might have been consumed by this brood, as they sometimes brought them one large fly, at other times two, three, four, five, and even more flies of different sizes."

The spotted Flycatcher is not quite six inches in length from head to tail. The head and back of the bird are of a chestnut-brown colour, while the wings and tail are of a darker brown ; the breast and the under parts vary from greyish-white to greyish-brown ; the legs and bill are dark brown. On either side, at the base of the bill, there are numerous hair-like pointed projections, or short bristles, which are peculiar to a few species of insectivorous birds, and serve to prevent insects from getting on the bill. The female is slightly smaller than the male, but almost identical in colour.

The spotted Flycatcher constructs its nest of stems of grass, horsehair, moss, lichens, and wool, lined with feathers, in a hole in a wall or tree, or in the fork of a tree, on beams in outhouses, ledges of rocks, in fruit trees nailed to walls, and on the stumps of trees. It returns to its old nesting haunts and often avails itself of the old nests of other birds. The eggs are usually five in number, varying in colour from pale green to bluish-white, mottled with rust-coloured and purple spots. Apparently there are two broods in the year. Owing to its extraordinary insectivorous propensities and its perfect harmlessness, this little bird ought to be carefully protected and encouraged to increase in numbers.

4, Whitehall Place, S.W.
January, 1899.
Revised, September, 1902.

THE SPOTTED FLYCATCHER.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of Application so addressed need not be stamped.

Leaflet No. 55.

BOARD OF AGRICULTURE AND FISHERIES.

The Swallow.

(*Hirundo rustica.*)

FIG. 1.*

Male Swallow, and tail of Female. ($\frac{3}{5}$ths natural size.)

This bird is sometimes called the "Chimney" Swallow, sometimes the "Barn" Swallow. Macgillivray says that the former name is not quite correct, as the Swallow rarely builds in chimneys. He distinguishes it from the Martin, *Hirundo* (*Chelidon*) *urbica*, by calling the first the "Red-fronted," and the Martin the "White-rumped."

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* The illustrations are taken from "Coloured Illustrations of the Birds of the British Islands," by Lord Lilford, by the kind permission of the publishers.

There is considerable confusion between the Swallow and the Martin, and this is accentuated by the similarity in their habits and their appearance in this country at about the same time. They may be distinguished thus :—

Swallow.	Martin.
Forehead and throat chestnut brown.	
Upper surface steel blue, including the rump.	Upper surface steel blue except the rump which is white.
Lower surface dusky reddish white. (The female has lower surface whiter).	Lower surface white.
Tail markedly forked. (The female with outer feathers of tail shorter.)	Tail not so markedly forked and wings shorter.
	Feathers on feet and toes.
Eggs white, but speckled with brown or dark red spots.	Eggs pure white.
Nest open at the top.	Nest with a small hole only, for entrance.

The Sand Martin is smaller than either of these two birds, and its upper surface is brown or mouse coloured.

The Swallow, the Martin, and their ally the Sand Martin (*Hirundo riparia*), are of great benefit from an economic point of view, as insect destroyers. They live solely upon insects, which they catch mainly when on the wing, though they may often be seen taking them from the surface of water, and sometimes from the ground. Swallows take insects of many kinds, although probably their commonest food consists of species of two-winged flies. When the large species of *Tipulidæ*, such as *Tipula oleracea* (the Daddy Longlegs), *Tipula maculosa*, and other "Crane flies," come from the pupal form towards the end of the summer, and fly heavily over the fields, pastures, and lawns, they are eagerly seized by the swallows, which fly low to secure them. Swallows have been observed destroying quantities of the "hop flies," or aphides (*Phorodon humuli*), as they leave the hop gardens for their winter quarters on the neighbouring plum and damson trees, from which they come again in the early spring and go to the hop plants. The migrations of these insects afford a fine harvest for swallows, but unfortunately the latter are now so reduced in numbers that their influence in keeping down "hop flies" is much less effective than formerly. It is said by some observers that the regular recurrence of hop aphis attacks, known as "blights," year after year, and their alarmingly increasing intensity are due to the absence of swallows. This increase is, however, more probably due to the plan of planting prunes in the alleys.

The Swallow (*Hirundo rustica*) has its throat and forehead chestnut-coloured, or reddish-brown, with its body of a bluish hue, and its wings and tail brownish ; the bill is black and the feet brown, or brownish-black ; under the wings and on the belly the colour inclines to buff. It is about eight inches from the head to the tail, and its wing expanse is fourteen inches. There is but little difference in the appearance of the sexes ; the tail of the female is, however, shorter than that of the male, whilst the underparts are whiter and there is less black on the breast.

This bird appears in our country, as a rule, about the beginning of April, reaching the North of Scotland about the middle of May. Its nest is composed of mud or dirt mixed with bits of straw or dried grass and hair, and is lined with fine grasses and feathers. It is not covered like the Martin's nest, and is placed under the eaves of barns and many other buildings, on the beams and joists of out-houses, under gateways, and beneath the arches of bridges. The eggs, of which four or five are usually laid, are white, speckled with brown or dark red spots. Normally there are two broods. The young of the first brood generally fly towards the end of June, and the second at the end of August.

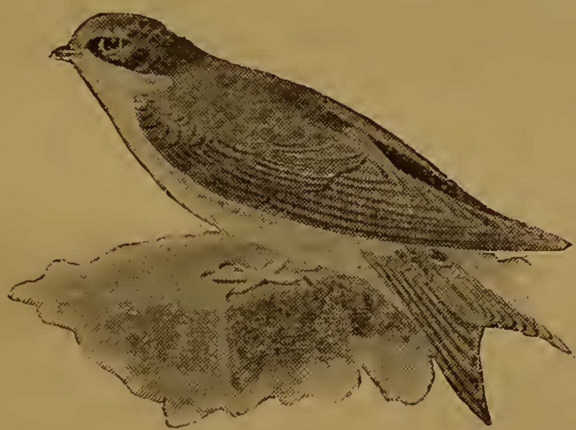


Fig. 2.
The Martin. ($\frac{3}{5}$ths natural size.)

About September the birds congregate and betake themselves at night to trees to prepare for their long flight to warmer regions in Africa, where they pass the winter. All the Swallows do not leave in the first flight. The young birds may go first and the old birds later, the last flight taking place at the end of September or even in October.

The continued decrease in the numbers of Swallows and Martins is a serious loss to agriculture. It seems that there are two reasons for this diminution, one being the slaughter of the birds in the South of Europe, both for food and for purposes of millinery ; the other reason being the disturbance to which they are subjected by the ubiquitous Sparrow, whose numbers have largely increased in late

years. The places where Swallows have been accustomed to build are occupied by Sparrows, whose pugnacity and overbearing spirit will not allow any other birds to come near them.

The Swallow is not included in the schedule to the Wild Birds Protection Act of 1880; but a special close time has been prescribed for its protection in certain counties, and its eggs are also protected in several counties.

4, Whitehall Place, S.W.,
January, 1899.
Revised, November, 1904.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

The "Canker" Fungus.

(*Nectria ditissima*).

The term "canker," as used by fruit growers, is applied to any disease of fruit trees, independent of its origin, where the bark becomes cracked and more or less destroyed. It is, however, very important that the true cause of the canker should be ascertained, otherwise preventive measures cannot be applied with any certainty of success, as the remedy most effective against one particular form of canker may prove useless against another kind of different origin.

The most frequent and at the same time most destructive form of canker attacking apple trees in this country is caused by a minute fungus (*Nectria ditissima*), and as the general appearance of the wounds produced is very well marked no difficulty should be experienced in recognising this particular form.

The fungus can only gain admission to the living portion of a branch through a wound, being unable to pierce the unbroken bark. In the case of slender branches the wounds may be caused by frost, hail, or the punctures of insects. Having once gained an entrance the fungus spreads rapidly in the living bark, which becomes eaten away in irregularly-shaped patches leaving the wood exposed. In some cases the wound is confined to one side of the branch, but in many instances the bark is completely destroyed all round the branch, when the portion above the wound is at once killed. In very young branches the wood is also frequently destroyed as shown in Fig. 1. A very characteristic feature of the disease, when attacking young branches, is the thick rugged mass of bark which forms round the edge of the wound.

On older parts of the tree canker usually first appears in the fork of a branch, access being gained by the fungus through a crack caused by the over weighting of the branch with leaves or fruit. In this case deep, more or less curved, cracks first appear in the bark, which is finally destroyed, leaving irregular patches of naked wood. After becoming well established the fungus travels up the branch in the bark and bursts through to the surface at different points along its course, and by this means the branch is eventually killed.

In addition to the symptoms described for the recognition of true canker the fungus itself may be found if carefully looked for. During the wane of summer patches of minute white specks may be seen nestling in crevices of the rugged bark surrounding the wounds; these are the first form of fruit produced by the fungus. In the spring these white patches produce a second form of fruit consisting of very minute bright red balls. A magnifying glass, which can be purchased for a shilling, greatly assists in detecting these minute bodies, the presence of which settles all doubt as to the cause of the disease.

During the winter months, when the characteristic white fluff has disappeared, the swellings and wounds caused by the American Blight (*Schizoneura lanigera*) somewhat resemble the wounds made by the canker fungus, but careful observation will reveal the presence of the Blight insect in the cracks.

Some kinds of apple tree are more susceptible to the attack of the canker fungus than others. Those which yield some of the best eating apples are most liable to it. Cox's Orange Pippin is a variety subject to this disease, as are also the Ribston Pippin, the Golden Pippin and several of the Rennets or Reinettes, notably Reinette des Carmes. Trees with the thinnest and smoothest bark are most liable.

Pear, plum, oak, beech, ash, hazel, alder, maple and lime trees are also attacked by the canker fungus.

Prevention and Remedies.

Young branches that are attacked should be cut off, as they are certain to to be girdled and killed at an early date.

When thick branches are diseased all the wounded parts should be cut away and the cut surface luted with clay or protected with a coat of gas tar. If the disease has spread from the original point of infection, and appeared at the surface in other places, the branch should be cut off.

It is very important that grafts should not be taken from diseased trees, as parts that appear to be sound may contain the fungus in their tissues.

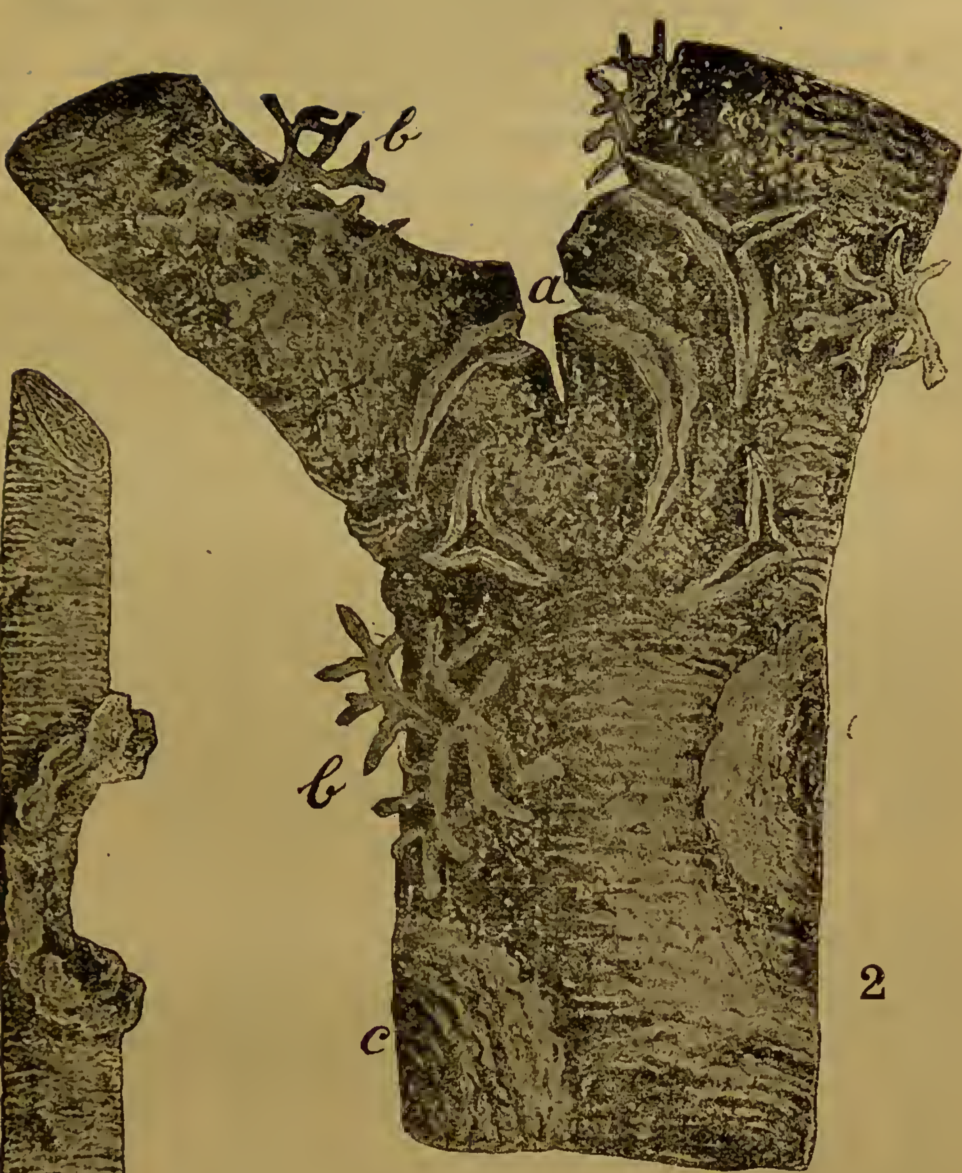
The white stage of the fungus can be killed by applying with a brush a solution of sulphate of iron—1 lb. to a gallon of water. This mixture will also destroy lichens and moss growing on the trunk and branches.

Description of the Figures.

1. A young branch of apple tree badly attacked by the canker fungus.

2. A stout branch of an apple tree attacked by the canker

2



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3

fungus. The fungus gained an entrance through the crack at *a*, and caused the curved cracks in the bark. At *b* and *c* lichens are growing on the bark.

3. A crack in the bark caused by the canker fungus. The groups of fungus fruit are seen springing from the sides of the wounds.

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BOARD OF AGRICULTURE AND FISHERIES.

External Parasites of Poultry.

The parasitic infestation of poultry causes far more loss than most breeders imagine. Birds are rarely examined, and the cause of their poor condition is not ascertained or even considered. The evil is allowed to spread unmolested, in many instances it spreads with great rapidity, and a general weak and unhealthy condition results. The chief parasites of poultry are insects, mites and worms.

These parasites are most injurious to young chicks and "brood" hens. The persistent loss of chicks, and the failure of hens to bring off their young, are often due to the irritation caused by the presence of parasites upon their bodies—enemies that are frequently unsuspected. The insect and mite pests weaken the constitution and predispose to other maladies, such as diphtheritic roup and "gapes"; in many cases they have been the forerunner of these worse epizootic diseases. Parasites on the young birds stunt their growth. What is termed "Scaly-leg" is due to a parasite—a mite. Another species of mite at the roots of the quills causes birds to pluck their feathers.

There are three distinct groups of insect and mite pests upon fowls, namely:—(1.) Fleas (*Pulicidæ*); (2.) Biting Lice (*Mallophaga*); and (3.) Mites (*Acarina*). The two former only are true insects, having the six insect legs; the *Acarina* have four pairs of legs when adult and are quite distinct from true insects. The fleas and some of the worst mites are armed with a piercing and sucking mouth; the bird lice have biting mouths. The pests with piercing mouths weaken the birds not only by causing irritation but by actual robbing of blood. The biting lice, on the other hand, only cause severe irritation, which keeps the birds in constant unrest. Most birds have each their distinct parasites, each species of louse only flourishing on a particular species of bird; duck lice, for instance, cannot live permanently upon fowls, and *vice versâ*.

Different species also seem partial to particular parts of the bird's body. The favourite positions seem to be the head, neck, rump, and under the wings. Some of these parasites live permanently on their hosts (lice and some mites), whilst others (fleas and some mites) go to and fro. Some mites live entirely upon, and even under, the skin, keep amongst the feathers and at their roots; some lice live like "ticks," with their heads against the skin and their bodies erect; whilst a single genus (*Lipeurus*) (Fig. 4) lives

between the barbs of the feathers. All these parasites are encouraged by dirt.

(1.) FLEAS (*Pulicidæ*).—The fleas, which are true insects, belong to the order of flies (*Diptera*). They feed upon the blood. One species only lives upon the fowl, namely, the Hen flea (*Pulex gallinae*). This flea is abundant in dirty fowl runs, and especially in the nests where straw is used. The adult flea is dark in colour, and, as in all fleas, is devoid of wings. The fleas are provided with very sharp piercing mouths. The fleas are not noticed on the birds because they generally attack them at night; then, however, they do much harm, causing constant irritation and loss of blood, and depriving them of rest.

Life-history of the Hen Flea.—The female flea lays her eggs (nits) chiefly in the nests amongst dust and dirt and in the crevices of the walls and floor. These nits give rise to pearly white maggots, with brown horny heads, which can often be found in the bottom of the nests amongst the dust (Fig. 1). These larvæ are mature in two or three weeks,

FIG. 1.

Larva of hen flea (greatly enlarged).

when they reach about one-sixth of an inch in length. In warm weather they may be full fed in even ten days. They then spin a pale cocoon amongst the dirt, in which they pupate. The pupa (Fig. 2) is at first pale brown, then dark

FIG. 2.

Pupa of hen flea (greatly enlarged).

chestnut brown. In this condition the flea remains ten to twenty-one days, when the pupa hatches into the adult. Hen fleas breed all the year round, but chiefly in warm weather. It is well to remember that, whenever there are dark and dirty hen roosts, there are sure to be numbers of fleas.

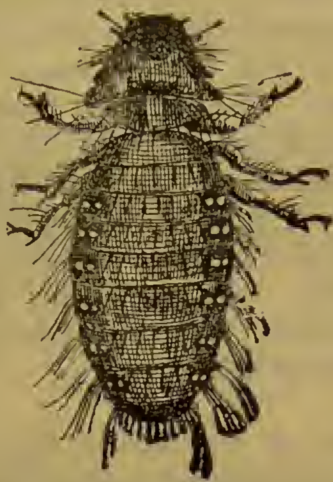
(2.) BITING LICE (*Mallophaga*) (Figs. 3 and 4).—The bird lice belong to the group *Mallophaga*, quite distinct from human lice (*Pediculidæ*) and from mammalian lice (*Hæmatopinus*, &c.). These lice have not a piercing mouth, their mouth being used for biting and cutting. They subsist

upon the productions of the skin and fragments of feathers. They cause violent itching, and bite sharply, and must produce

FIG. 3.

Two Species of Fowl Lice.

Fowl louse (*Goniocotes hologaster*) (greatly enlarged).



Fowl louse (*Menopon pallidum*) (greatly enlarged).

considerable pain when present in large numbers, as is too often the case. The feathers, especially the saddle hackle, generally show notched edges with lice infestation. Eight distinct species of lice attack fowls. The presence of these lice is generally ascribed to too uniform or insufficient nutrition, or also to damp, dark, and dirty runs, especially those badly ventilated. Food, either when uniform or insufficient, has no effect upon their presence. Dark damp places, however, when dirty, are sure to harbour all these pests, especially when badly ventilated. It is also said that breed affects their presence, but observation tends to show that all breeds are more or less subjected to infestation. In every case they set up severe irritation and inflammation of the skin, which often leads to stunted growth, and even death. Lice and other parasites flourish on unhealthy birds.

Life-history of Lice.—All the lice breed fairly rapidly. The eggs or nits are laid upon the down feathers, as a rule ;

FIG. 4.

Fowl louse (*Lipeurus variabilis*) (greatly enlarged).

they are often beautifully sculptured objects, oval in form. In about six to ten days they hatch into small pale, active,

lice, which at once commence to irritate the birds. The adults are occasionally found in the nests. Before reaching the full-grown state these lice moult their skin ten or twelve times, there being little difference in each stage, except the gradual darkening of the markings.

Menopon pallidum (see *Fig.* 3) is the most troublesome of the fowl lice, and it runs with great nimbleness among the feathers. The head in front is somewhat angular and somewhat crescent-shaped. The temples are rounded and bear four bristles and a few hairs. The abdomen is oval and elongated, and each segment carries a series of bristles. The colour is pale yellow, with bright fawn spots on the abdomen. *M. pallidum* has been kept alive for months upon fresh feathers, when the quill epidermis especially was consumed.

Lipeurus variabilis (see *Fig.* 4) may be found in considerable numbers among the feathers of the fowl, especially in the primary and secondary wing feathers. It has a narrow body, and the prevailing colour is pale yellow with dark coloured bands and fawn-coloured spots. The lice are very small, the male measuring 1·9 millimetres and the female 2·2 millimetres. (There are approximately 25 millimetres to an inch.)

Two other forms belonging to the same section may infest chickens, viz., *Goniodes dissimilis* and *Goniocotes hologaster* (see *Fig.* 3). Compared with *Lipeurus*, their bodies are flatter and wider. *Goniodes dissimilis* measures, the male almost 2 millimetres and the female 2½ millimetres. The head is wider than its length, the abdomen is broad and oval, and it bears two bristles on the middle of each segment, and three or four at the edges where curved spots also occur. The general colour is whitish, the spots being darker, with fawn-coloured bands. *Goniocotes hologaster* is much smaller than *G. dissimilis*, the male being ·9 millimetres and the female 1·3 millimetres in length. The head is as wide as it is long, and it is broadest just behind the antennæ. The insect is of a yellowish colour which darkens at the thorax, and it has brownish black bands.

Prevention and Treatment of Fleas and Lice.—Infestation is always worst in dirty and neglected runs and roosts, and such are a standing danger to more cleanly neighbours. Cleanliness and freedom will always put these pests under a disadvantage, not only cleanliness of the nests, walls, and floor, but also of the ceilings and perches. To suppress these pests the houses should be cleaned down at least twice a year with a wash made of hot lime and soft soap, the ceilings, walls, and nests having

a good coating; the wash should be fairly liquid so as to run into every crack and crevice.* Early spring and autumn are the times for these applications. The perches are best treated with boiling water and soft soap, or with an emulsion of kerosene. It is important that houses should be well built, with as few cracks and crevices as possible, for in such harbours these pests congregate and may escape from any wash used.

Special attention should be paid to the nests; they should be frequently cleansed and changed to keep off fleas and other parasites. Neither nest-boxes nor perches should be fixed, relays of each should be at hand, so that they can be changed to ensure complete disinfection. The nest-boxes should be now and then cleaned out, and dressed with hot lime. Either dusting the prepared nests with fresh Persian insect powder (*pyrethrum*) or putting a little sawdust or sand soaked in naphthaline at the bottom will keep off these depredators. Pine-wood shavings, or wood-wool, in the nests instead of straw is most beneficial. No lice or fleas will live in it, owing to the aromatic odour given off from the wood. Care, of course, must be taken that the remedies employed do not affect the eggs in the nest.

Regarding the infestation of the birds themselves, white precipitate seldom fails. The heads and necks of young chicks should be early dressed very sparingly, and this treatment should be repeated when necessary. White precipitate is a strong irritant poison, and needs the greatest care in its use, especially in young chicks. It is best obtained as an ointment from the chemists. Hens selected for sitting should have a small quantity of this ointment rubbed in under the vent-head, and sides, and then be well dusted with insect powder (*pyrethrum*). Sitting hens are greatly tortured by parasites, and their young are often lost by neglect of these simple precautions. Dust-baths are the natural remedy for lice and mites, and fowls should never be kept without them Sand and road dust, mixed with a small quantity of paraffin, will generally keep the birds free from vermin. In place of paraffin *Pyrethrum* powder may be used with the dust. Some poultry keepers find that when paraffin is added the birds avoid the dust-bath.

The supposed connection between "Gapes" and "Lice."—It has been stated that there is a connection between lice and the nematode worm, *Syngamus trachealis* (the "red-worm" of gamekeepers), that produces "gapes" in fowls and pheasants. The one is thought to give rise to the other in some mysterious way; needless to say there is no

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* To every gallon of lime-wash add ¼ lb. of soft soap, previously dissolved in boiling water.

connection whatever. The life-history of that destructive scourge, the gape-worm, has been clearly traced, and it is known that no intermediate host is required for its development.

(3.) MITES (*Acarina*).—Mites are very minute creatures, having four pairs of legs when adult. Some live on the birds *at night*, as the red hen-mite (*Dermanyssus avium*) (Fig. 5); others are permanent parasites, *e.g.*, Itch mites or *Sarcoptes*, living at the base of the feathers, and

FIG. 5.

Dermanyssus avium and ovum (greatly enlarged).

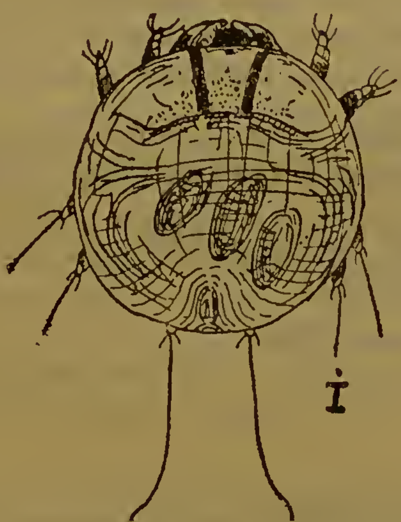
popularly called "Depluming scabies" (Fig. 6); or, living under the skin, forming scabby growths, such as are seen on fowls' legs (*Sarcoptes mutans*). These skin mites which are armed with a pricking mouth, with which they torment the birds, especially at night, cause loss of condition, hinder sitting, and create loss in other ways.

A very injurious form is the red or common fowl mite. *The Red Fowl Mite* (*er manyssus avium*).—This very minute creature is yellowish white to dark red in colour, according to the amount of blood it contains, drawn from the birds. The mites are found in abundance in pigeon-houses and poultry-roosts and often attack cage birds. Both sexes are armed with a sharp rostrum; the female is most bloodthirsty. They feed upon the birds only at night, and hide away in cracks and crevices in the nests, perches, floors, walls, and ceilings during the day. Numerous colonies can be found in the nests, especially in straw nests, with countless eggs and young forms, and quantities of cast skins. They are most prolific, and can remain for months without any live host to feed off; hence the removal of the birds from the runs is useless as a remedy. The eggs hatch rapidly. The young are at first silvery white, with six legs. They moult their skin a number of times, the cast skins forming a whitish or silvery powder often seen on the perches. As the mites grow older they become darker in colour. Light and air are distasteful to them; damp,

dark, and badly-ventilated roosts are where they flourish best. Breeding is especially rapid in spring and summer. This mite is often unobserved, owing to its strict nocturnal habits, and hence the cause of the fowls keeping backward, and even dying, is not understood. Birds should, when looking dejected and emaciated, be examined at night, and if mites are found treatment should be at once resorted to. Transmission to man and other animals (*e.g.*, horse, dog, cat), is not unusual, but, although the mites for a time cause severe irritation, they will not remain for any length of time, and readily yield to treatment. Hens should not be permitted to roost in stables and sheds where other animals are kept.

FEATHER-EATING OR DEPLUMING SCABIES.—Feather-eating in poultry is often due to a minute parasitic mite (*Sarcoptes laevis*) at the roots of the feathers. It is generally supposed to be due to a "vicious habit"; numerous absurd theories, such as idleness and thirst, having been put forward to account for it. There are two kinds of feather-eating, viz., "self-feather-eating" and the plucking of other birds' feathers. The former is chiefly due to the mites living upon and irritating the roots of the quills. The form on the fowl makes its appearance about April, and is most prevalent in spring and summer. Beginning at the rump, the disease may spread to other parts, the head and neck often being badly affected. The mites can be easily found amongst the white powdery matter at the base of the quill. The fowls pluck out the feathers to destroy the irritation

FIG. 6.



Sarcoptes laevis. Egg-bearing female (greatly enlarged).

caused by the mites at their base. Lice, also, are partly accountable for feather-plucking. The birds in picking at the mites and lice pull out the feathers.

Prevention and Remedies.—As the mite disease is contagious, isolation of the affected bird is the first step, especially if it be a cock. The mites readily yield to treatment with oil of cloves rubbed into the infected area. One part of creosote to 20 of lard or vaseline is still more successful. Another measure is to wet the base of the feathers with soapy water, and then dust the birds with fresh pyrethrum.

SCALY LEG.—This well-known disease is again due to a mite (*Sarcoptes mutans*). This complaint is a serious matter and very prevalent. The scales of the legs and feet become raised and separated, and a chalk-like excretion accumulates between and over them. Rough lumpy crusts are formed, and under these and the scales the mites live and breed. The disease is slightly contagious, and may pass to other birds than fowls. Infected birds are lame, they have a difficulty in perching, and they fall off in condition.

Prevention and Remedies.—Isolation of diseased birds is most essential. Removal of the crusts without causing bleeding, and then the application of creosote (one part) and lard (20 parts), will be found sufficient. The legs should be previously bathed in hot water in order to soften the crusts. A mixture of equal parts of flower of sulphur and vaseline rubbed into the limb also cures this complaint. In every case the limb, some days after treatment, should be well cleaned with hot water and soft soap. It is most important that any new stock should be examined, especially the cock, and if any signs of parasites are seen they should be cleared off before the birds are given their freedom. If exhibits of poultry infested with parasites were prohibited by poultry-show committees, it would force attention to the subject in a way that could not fail to greatly reduce parasitic infestation.

The pests mentioned in this leaflet are very small, and a good lens or microscope is required for their examination.

4, Whitehall Place, London, S.W.
August, 1899.

Revised, August, 1904.

BOARD OF AGRICULTURE AND FISHERIES.

Internal Parasites of Poultry.

The internal parasites of poultry are numerous, but only two serious diseases are caused by such agents. The chief internal parasites are worms, but an often fatal complaint in fowls, Diptheritic Roup, is due—at least, in part—to minute single-celled animals known as Protozoa. Another fatal disease is due to similar forms in the liver. The most important disease caused by worms is Gapes.

I. The Gape Worm (*Syngamus trachealis*).

The Gape Worm (*Syngamus trachealis*), male and female (mag., line showing natural size).

Gapes is a disease caused by a nematode or round-worm which takes up its abode in the windpipe and sometimes in the bronchial tubes. It is called scientifically *Syngamus trachealis*. The Gape-worm is also known as the Red-worm and Forked-worm. Not only fowls and turkeys, but pheasants, sparrows, linnets, starlings, rooks, partridges, martins, swifts, and green woodpeckers are also invaded by this parasite. The disease is caused by the worms taking up their abode in the air-passages, and there irritating the lining membrane, causing inflammation. These pests, if present in large numbers, also block up the windpipe and stop the passage of air to the lungs. In both ways the birds may succumb.

The Gape-worm is nearly always found in copulâ inside the host; the small male worm being permanently attached to the female towards her head end, and the two worms making a fork; hence its name the Forked-worm. In colour the Gape-worm is red, often bright red, and in length the female may reach four-fifths of an inch, the male seldom more than one-fifth. There is great variation in size, some

females being only one-fourth of an inch long. As a rule, a number of worms may be found together in the fowl's windpipe, often as many as twenty crowding in one particular part of the tube.

The *symptoms* of gapes are a curious listless gaping of the mouth, a wheezing cough and stretching forward of the neck, and the frequent appearance of frothy saliva in the mouth and sometimes in the nostrils.

When the female worm becomes mature and full of eggs, she and the attached male are expectorated by the bird. These worms lie about on the ground, etc., and sooner or later burst, when the minute eggs, not $\frac{1}{250}$th of an inch in length, are spread over the ground or in the water. Each worm contains a great number of eggs. It will thus be seen that land may soon be contaminated by a few birds suffering from this disease. The eggs hatch in damp places and in water into small white embryos. Both eggs and embryos, on entering a chick, develop direct into the Gape-worm.

Experiments have shown that birds fed with ova and embryos of *S. trachealis* will develop gapes, and thus no second host, such as we find in the tapeworms, is necessary. Although a second host is not necessary, numbers of the eggs and embryos are swallowed by earthworms, and doubtless fowls very often contract gapes when eating these worms, which thus act as carriers of the disease.

It is chiefly in chicks and turkey poults that gapes causes the greatest mortality, although old birds are sometimes attacked. The birds obtain the embryos especially from polluted water and from damp ground, but also through the agency of earthworms. That wild birds play some part in its dissemination is also extremely probable.

Prevention and Remedies.

Any bird showing signs of the disease should be isolated. Chicks should not be kept with the stock birds. Fresh breeding ground should be used if possible every year. The worst outbreaks are always on overstocked land. Water vessels should be kept scrupulously clean and only pure water given to the birds. The drinking troughs are best cleansed by being put in boiling water and well scalded.

The worms may be partly removed from the windpipe by means of a feather dipped in oil of cloves or eucalyptus oil pushed down the windpipe and turned round and round. Such treatment, however, will fail to reach the worms situated lower down in the bronchi. A fumigating box, in which several birds can be placed at once, is useful; either *Camlin powder* or finely ground chalk and camphor blown into the box will loosen the worms, which the birds will expectorate during the violent fits of coughing the powder produces.

The following remedy has been found successful by a correspondent:—"Take the bird affected in one hand, and opening its beak with the thumb and finger, place in its mouth a piece of camphor about the size of a small pea, then close and hold its beak for a moment to compel the bird to swallow the morsel, and the operation is complete. A second application is seldom necessary."

It is most essential that all chicks which die from gapes should be burnt or otherwise destroyed.

If the birds are kept in small runs, the run should be purified, after an outbreak, either with gas-lime, or watered with a 1 per cent. solution of sulphuric acid.

II. White Intestinal Worms.

Although death is not frequent from intestinal worms, of which both round worms (Nematodes) and flat worms (Cestodes) are present, yet debility is very often caused by Nematodes—especially by the White Intestinal Worm (*Heterakis papillosa*). These small white or creamy-coloured worms are about one-third to half an inch long, and are chiefly found in the beginning of the small intestines and generally in groups of from ten to fifteen. Sometimes they form a plug which blocks up the alimentary canal. Birds infected with them are usually ravenous and yet keep losing condition.

The eggs or embryos are probably obtained from dirty water, but also off the ground. Diseased birds should be isolated. The worm can easily be expelled by a dose of thymol; one grain made up in a dough pill and administered morning and night. Similar good results have sometimes been obtained by the use of three grains of santonine given in the same way.

III. Diphtheritic Roup.

Diphtheritic Roup is one of the most contagious diseases from which fowls suffer. It is due—at least in part—to certain very lowly organised, single-celled animals, called Protozoa, which invade the lining membrane of the mouth, pharynx, and even the crop and windpipe. This virulent disease manifests itself either as loose yellow cheesy patches or as small firmly-fixed nodules in the mouth, the latter especially around the tongue and beak. In these false membranes and the tissues beneath them may be found the minute parasites which either directly or indirectly cause the false growths. Certain authorities state that bacteria are the active agents, but the probability is that these Protozoa are entirely accountable for the disease. If left alone a diseased bird is almost sure to die.

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Prevention and Treatment.

It is most important that any bird showing symptoms of this complaint should be at once isolated, and the drinking vessels, etc., in the run well disinfected by boiling or by the use of strong carbolic acid.

The loose growths should be very carefully removed with a blunt knife or two blunt needles, and the mouth well washed out with a 10 per cent. solution of salicylate of soda or boracic acid. Probably several operations will be necessary as some small diseased areas may escape notice. In any case the mouth is best treated several times with the disinfectant. The hard patches may be burnt away with lunar caustic. Every dead bird should be carefully destroyed, and the run or yard disinfected either by sulphuric acid or by a dressing of fresh gas-lime after an outbreak. The best results in treatment have been obtained with salicylic acid or salicylate of soda, and it is advisable to place a ·1 per cent. solution for the fowls to drink for a week after any signs of the disease have been noticed in a run. In no case should a bird be allowed freedom until it has been completely cured. When the disease is very advanced, it is best to kill the bird and destroy it; but if taken in time, a cure can easily be effected.

Another disease closely related in origin to this form of roup, and often found with it, is a comb and wattle disease called *Epithelioma contagiosum*, which appears as yellowish-brown nodules varying in size from a pin's head to that of a bean. A hollow, from which a yellow fluid oozes and forms a brownish crust or scab, appears in these nodules. The parasites are minute protozoa, which invade the skin of the comb. The best treatment seems to be painting the diseased areas with oil of turpentine and isolating the bird.

Another disease due to similar forms of life attacks the liver. Yellow cheesy spots appear on the liver, especially in turkeys. This parasite is an *Amoeba*, and often causes considerable loss.

To avoid all parasitic diseases of poultry, it is very important that fresh stock birds should be well examined before being turned out, as a single diseased bird, especially if it be a cock, may soon contaminate a whole run.

4, Whitehall Place, London, S.W.,
October, 1899.
Revised January, 1903.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Improvement of Land Act, 1899.

(62 & 63 Vict. c. 46.)

The Board of Agriculture desire to call attention to the provisions of the Improvement of Land Act, 1899, which has been passed with a view to give increased facilities to owners of land desirous of carrying out agricultural and other improvements with the aid of borrowed money. With this object the new Statute amends the Improvement of Land Act, 1864, and other Acts authorising the creation of rentcharges for the improvement of land.

Under the new Act the maximum period over which rentcharges authorised after the commencement of the Act may be allowed to extend is 40 years. It must not, however, be assumed that the full term will always be applicable. The period to be allowed in each case will be determined by the Board, regard being had to the character and probable duration of the improvement.

By another provision the land charged with the payment of the rentcharge may be land other than that which is directly improved; provided (*a*) that such other land is shown to the satisfaction of the Board, by statutory declaration, to be held for the same estates or interests, and to be either subject to the same incumbrances (if any) or to be free from incumbrances; and (*b*) that in the opinion of the Board such other land may properly be included in the charge.

Improvement Companies are empowered (by resolution passed by three-fourths of their shareholders present at an extraordinary meeting) to adopt, as improvements authorised by their own special Acts, all or any of the improvements authorised by the Improvement of Land Act, 1864, or by any enactment amending it.

The Board of Agriculture are empowered to extend the period of repayment of improvement charges created (whether before or after the passing of the Act) in respect

of the planting of woods or trees, on application made by the landowner, not sooner than seven and not later than ten years from the date of the Order creating the charge, but subject to the consent of the persons entitled to the charge.

The new Act extends to Scotland certain additional improvements already authorised as regards England and Wales and Ireland by the Limited Owners Residences Acts, 1870 and 1871 ; the Limited Owners Reservoirs and Water Supply Further Facilities Act, 1877 ; Sections 30 and 25 of the Settled Land Act, 1882 ; Section 13 of the Settled Land Act, 1890 ; and Section 74, sub.-s. (1) (*b*) of the Housing of the Working Classes Act, 1890.

4, Whitehall Place,
London, S.W
November, 1899.

This leaflet is no longer issued.

BOARD OF AGRICULTURE AND FISHERIES.

Goat Moth (*Cossus ligniperda*) and Wood Leopard Moth (*Zeuzera æsculi*).

Goat Moth, larva, and pupa, all natural size.

The Goat Moth.

Trees attacked.

The caterpillars of this moth bore galleries in the stems of many species of broad-leaved trees, *e.g.*, willow, poplar, walnut, birch, elm, beech, lime, sycamore, ash, and various fruit trees. The softer woods are more commonly infested.

The caterpillars are large and a great number may be found at work in the same tree; the wood, on this account is so tunnelled and honeycombed as to be rendered useless for technical purposes.

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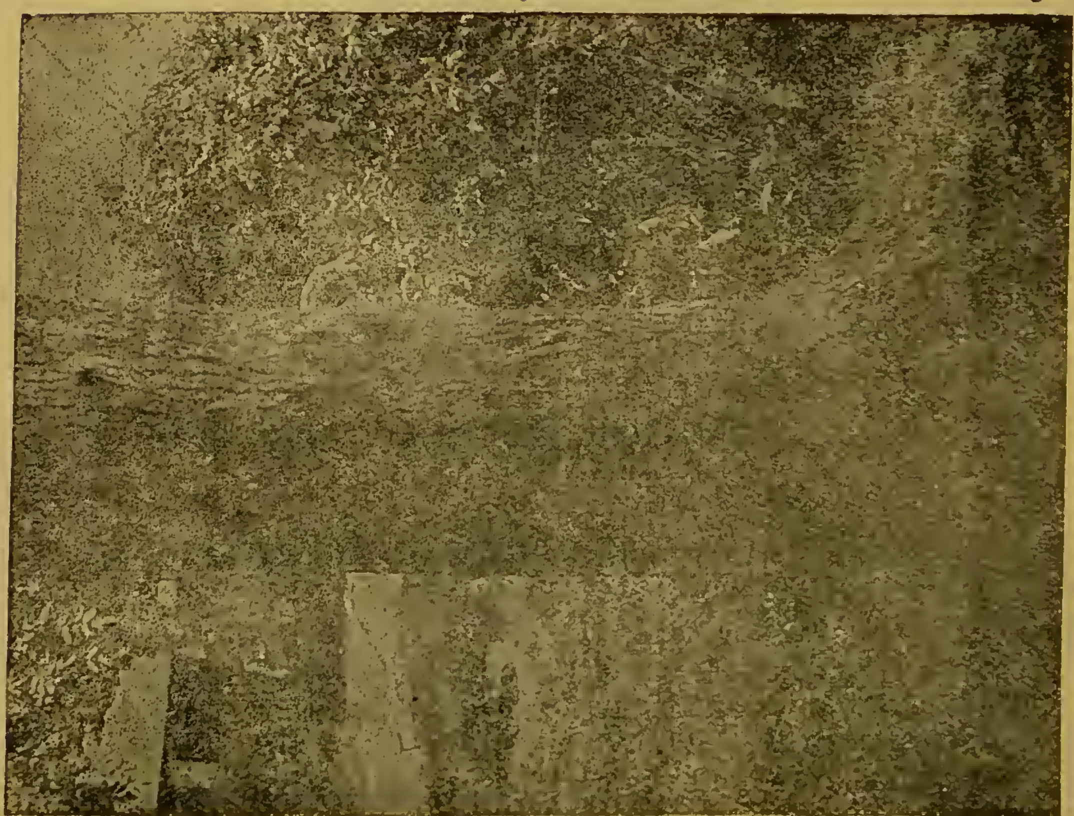

Fig. *a*. Ash Tree recently attacked by Goat Moth.

Fig. *b*. Portion of Ash Tree attacked by Goat Moth.

Figs. *a*, *b*, and *c*, from illustrations by **Mr.** W. E. Collinge, M.Sc., Birmingham University.

Indications of infestation.

(*a.*) The little heaps of excrement and frass thrown by the feeding caterpillars from their galleries to the outside.
(*b.*) The tunnelled stems broken by the wind.
(*c.*) The odour of the caterpillars (the walls of the galleries in the wood also smell), the odour being that of the acid distilled from wood; by some the odour has been compared to that of the goat.

Isolated trees, or those in an avenue or at the edge of a wood, are chosen by the females for their egg laying in preference to trees in close forest or close growth.

Fig. *c.* Portion of Ash Tree with larva of Goat Moth *in situ.*

Description.

Moth.—The goat moth, which flies at night, is large and plump. The female measures $1\frac{1}{2}$ inches or more in length, and over 3 inches in spread of wing; the male is somewhat smaller. The head is small and the eyes large; the proboscis

and antennæ are short. The antennæ of the male are distinctly comb-like, whilst those of the female are saw-like. The fore wings are pale-brown mottled with ashy-grey, and have numerous irregular black streaks and marks; the hind wings are darker greyish-brown. The thorax is densely hairy, brown and grey in front, and with a blackish band across it behind. The large heavy abdomen is grey with whitish rings.

Caterpillar.—The caterpillar is somewhat flattened, and hence the galleries are oval in shape. When young the caterpillar is dull pink, but as it grows it becomes yellowish flesh-coloured at the sides and on the under surface, the upper surface being red. The head is black; the segment behind the head bears a dark shield, and the segments have fine bristle-like hairs. The full-grown caterpillar may measure about 4 inches.

Pupa.—Pupation takes place in the burrow in the stem, near to the outside, the chrysalis being surrounded by a cocoon covered by wood chips and sawdust. Sometimes the caterpillar leaves the tree and pupates in the soil, in which case the cocoon consists chiefly of particles of soil.

Life History.

The moths fly in June and July; the eggs are laid in little heaps in cracks and crevices in the bark generally very low down, but sometimes up to the height of a man. The caterpillars on hatching feed at first below the bark, but later they gnaw irregular ascending galleries in the wood. In cases of overcrowding (and more than 100 caterpillars have been taken from one stem) some of the caterpillars may leave the tree and bore into another. When full grown the caterpillar pupates, and the pupation stage lasts about a month or on occasion somewhat longer. Before the emergence of the moth the pupa pushes its way partly out of the burrow in the tree, and the empty pupal skin may be seen projecting after the emergence of the moth. The cocoon has been found projecting from the soil of a garden near an infested balsam poplar.

The life cycle typically lasts for two years, *i.e.*, from eggs laid in July, 1905, caterpillars will hatch and bore below the bark. Passing the winter in the stem the caterpillars then tunnel in the wood, where they will live during the whole of 1906 and until June of 1907. Pupation will now take place, the moths issuing to start a new generation in July, 1907.

The Wood Leopard Moth.

Male Wood Leopard Moth; 1. Caterpillar, 2. Chrysalis; all natural size.

Trees attacked.

Like the Goat Moth this pest has importance both for the forester and the fruit-grower. The caterpillars of *Zeuzera æsculi* feed in the stem and branches of a number of broad-leaved species of trees, *e.g.*, lilac, lime, sycamore, birch, beech, oak, sweet chestnut, ash, willow, poplar, and such fruit trees as apple, pear, and cherry, where they may cause considerable harm. Though its specific name is that of the horse-chestnut the moth does not lay so much on it as on other trees, but its caterpillar galleries have been several times found in the very young branches of this tree, the tunnelled twigs hanging down broken by the wind. In the case of this moth, the caterpillars are not found many together in an attacked stem, but generally singly. The presence of the caterpillar may be betrayed by its copious out-throw of frass and wood-coloured excrement. The moth is frequently found in the Metropolitan districts, and sometimes causes considerable destruction to trees and shrubs in the public parks and private gardens of the metropolis.

Description.

Moth.—The moth, which is named "Leopard" on account of its spotted wings, measures between 2 and 3 inches in

expanse of wings in the case of the female, the males being smaller. The fore wings are white, with a number of black or blue-black spots. The hind wings are similarly marked, but the spots are fainter. The thorax is white, with 6 large dark spots arranged in pairs, and a smaller spot between the hindmost pair.

Caterpillar.—The full-grown caterpillar may measure 2 inches. It is white or yellow-white in colour with black spots; the head is dark, the joint behind the head bearing a black shield or plate, whilst a black plate is also present on the last segment.

The Wood Leopard Moth.—Figure showing young caterpillar, well grown caterpillar, pupa case, moth at rest, and a larval gallery.

Pupa.—The pupa is brown and may be found at first just below the place of exit; and later, empty from the emergence of the moth, it may—till the weather destroys or displaces it—be seen projecting from the tunnel in the infested tree.

Life History.

The moths lay their eggs singly on stems and branches late in June or July, and the caterpillar on hatching gnaws at first irregularly below the bark. After wintering the caterpillar bores into the wood, and the gallery or tunnel, running in the long axis of the infested stem, is round and regular and may reach 8 inches in length. The life cycle may take two years for its completion, when the dates quoted for the Goat Moth apply equally well in the case of the Wood Leopard Moth. The caterpillars have been known to leave their first feeding place and attack younger and fresher growths.

Preventive and Remedial Measures.

1. Where Leopard Moth caterpillars infest young branches or young stems, these should be cut and burned, as they would probably be killed in any case.

2. The galleries of the Wood Leopard caterpillars are regular, and in older stems a piece of wire or a strong twig pushed into the tunnel vigorously may reach and kill the caterpillar.

3. Trees infested with the Goat Moth caterpillars should be cut down and the brood destroyed.

4. As a preventive against the egg laying of the Goat Moth smear or paint over the lower part of the stem, up to the height of a man, with a mixture of clay and cow-dung, or a mixture of clay, soft soap, and paraffin.

4, Whitehall Place, London, S.W.
October, 1899.
Revised, July, 1905.

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BOARD OF AGRICULTURE AND FISHERIES.

Sheep-Scab.

Sheep-Scab may be described as a parasitic rather than as a purely contagious disease, affecting the woolly parts of the body, and due to the presence on the skin of a species of mite or acarus known scientifically as *Dermatodectes ovis*, or *Psoroptes communis*.

Identification.

The mature acarus or mite that causes scab in sheep measures $\frac{1}{40}$ to $\frac{1}{50}$ of an inch (·52 — ·62 mm.) in length, the female being somewhat larger than the male. The egg is about $\frac{1}{125}$ of an inch (·2 mm.) long. The immature mites (*see* larva, Figure 1) have only three pairs of legs, but when full grown, and capable of reproduction, they are provided with four pairs (Figure 2). Each foot of the first three pairs of legs of the male is furnished with a sucker-disc ; but in the case of the female this disc on the third pair of feet is replaced by long hairs (Figure 2).

Parasites very similar in form and size are also found on the horse, dog, and other animals, producing the disease commonly called mange, but the mange mite does not produce sheep-scab. It may therefore be accepted that where sheep become affected with sheep-scab they must have previously been in contact with diseased sheep, or with fences, posts, hurdles, or other objects against which diseased animals have rubbed.

Symptoms of Attack.

One of the first symptoms apparent in a sheep that has contracted scab is restlessness on the part of the animal, and a desire to bite the affected part, or to rub against posts, fences, or hurdles, or even against other members of the flock. This restlessness is the result of the irritation produced by the mites pricking the skin of the sheep in their endeavour to obtain food, and as they increase in number, the constant biting and rubbing of the sheep to allay the irritation causes injury to the skin, which is

followed by an exudation of serum, and the formation of crusts or scabs, under the edge of which the parasites and their ova are to be found.

As the mites increase in number they move from beneath the scabs to the more healthy parts of the skin and thus extend the area of the disease.

The injury to the skin produced by these mites is followed by shedding of the wool, and the fleece becomes broken and tufted, or matted together, giving the animal a ragged appearance. Even where the wool does not detach itself from the skin, it assumes a dead-white bleached appearance.

As soon as a sheep is found to present the above symptoms the owner should at once examine the animal, and, if he has any doubt as to the nature of the disease, he should call in the assistance of his veterinary adviser to discover whether the itching and rubbing are due to the presence of the sheep-scab mite, or to other causes.

The most convenient method of examining a piece of wool or crust taken from a sheep suspected of scab is to spread it out upon a dark surface, and place it in the sun or any other warm position. If it be a case of scab the mites will be seen as small dark specks moving about on the wool or perhaps on the surface beneath it. These moving objects should then be examined with a pocket lens or with a microscope of low power, when the parasites and their eggs will present the appearances seen in Figures 1 and 2.

FIGURE 1.

An immature Sheep-Scab Mite much magnified.

The parasites and their eggs are usually abundant in the crusts or scabs on the surface of the skin, and if a small portion of the crust and wool, after being softened in a

mixture composed of glycerine and a solution of potash or soda, is teased out and placed upon a microscope slide there will often be found, in confirmed cases of scab, whole mites, or portions of the detached legs, and eggs mixed up with the fibres of the wool and fatty matter, as represented in Figure 3.

It has been stated that the parasites of sheep-scab may be easily seen by the naked eye (but examination is greatly facilitated by the use of a pocket lens, or a low-power microscope), and now that the decisions of the Veterinary Inspectors of Local Authorities in Great Britain are followed by serious consequences to the owners if sheep are certified to be affected with scab, it is most important that no errors should be made in diagnosis. It therefore becomes necessary that all enquiries into reported outbreaks should be conducted on the above lines and with due care, because, unless the particular mite can be discovered the disease cannot properly be declared to be present.

Life History.

Since the life history of the sheep-scab parasite has a very important practical bearing upon that part of the Sheep-Scab Order of 1905 which deals with the dipping of sheep, it should be explained that after the parasite has been transferred from the diseased to the healthy sheep the female lays its eggs and dies. These eggs under favourable circumstances are hatched in about seven days, and the young female parasites, after undergoing the various stages of their development, arrive at maturity in about two weeks, when they, in their turn, proceed to lay eggs.

In all instances where sheep exhibit manifest evidence of scab, the wool contains not only living parasites but also eggs which may be newly laid, or on the point of hatching. While therefore one dipping, properly conducted, will have the effect of killing the living mites and destroying some of the eggs, it is absolutely necessary, if a perfect cure is to be established, to have recourse to a second dipping, which should be carried out not earlier than the 10th, nor later than the 14th day following the first dipping. If the dipping has been done with proper materials, two dippings will suffice, but if any doubt exists, a third dipping after a similar interval should be undertaken.

Preventive Measures.

Where sheep-scab exists, or is suspected, it is the duty of the owner of the sheep, under Article 1 of the Sheep-Scab Order of 1905, to give notice of the fact of the sheep being so affected or suspected to the nearest police constable; but in the absence of any suspicion of disease preventive

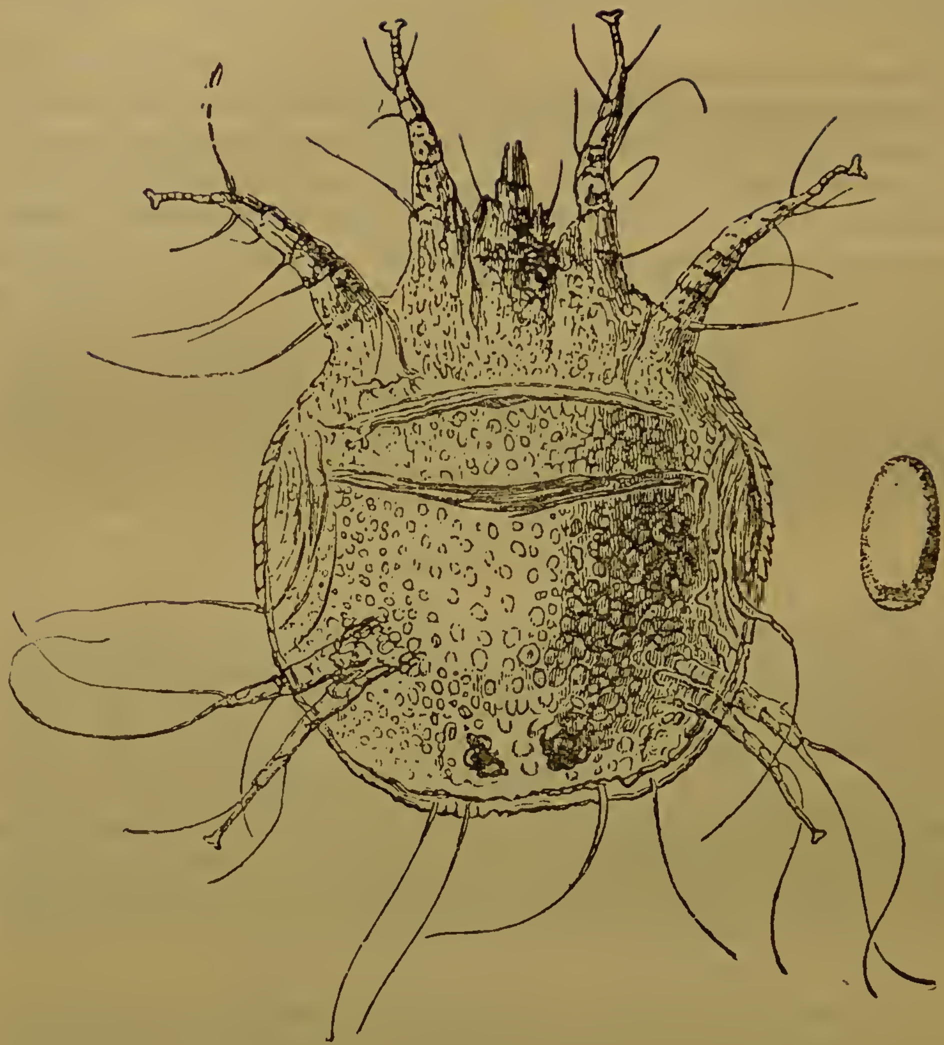

FIGURE 2.*

Mature Female Mite and Egg, magnified 100 diameters, from a sheep affected with scab.

* *The drawings in this leaflet appear in a pamphlet written for the Royal Agricultural Society of England by Sir George Brown, C.B., and are published with the permission of that Society.*

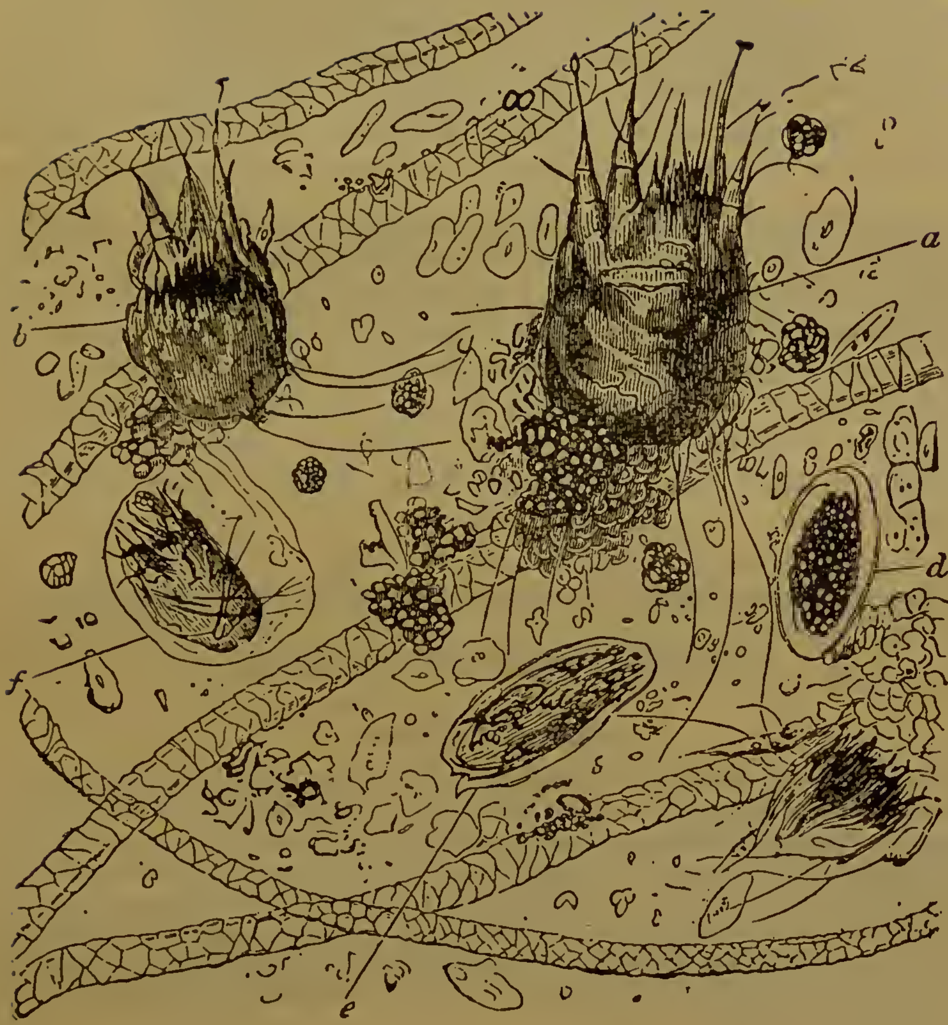

FIGURE 3.

Mites in various stages of development, intermingled with wool and masses of scab.

a. Mature female mite lying in a mass of scab.
b. Young mite after change of skin.
c. Cast-off skin of a mite.
d. Egg, with the yolk contracted.
e. Egg, containing a young mite.
f. Egg, with young mite in the interior about to be hatched.

measures against sheep-scab may with advantage be undertaken periodically.

Needless to say dipping will only be effective if proper materials are used, and if the operation is carried out in a thorough manner. The substances most commonly employed to kill the scab-mite are preparations of white arsenic, carbolic acid, tobacco juice, or sulphur. Some flock-masters compound home-made dips, but most rely upon one or other of the many patent dips that are now upon the market.

In pursuance of the recommendation contained in paragraph 34 of the Departmental Committee's Report* [Cd. 2,258] on Sheep-Dipping, the Board have incorporated in the second Schedule of the † Sheep-Scab Order of 1905 particulars as to the composition of three preparations which have been proved by experiment to be suitable for use as sheep-dips without detriment to the fleeces of the animals dipped, and, if properly employed, to be effective against sheep-scab,—as follows :—

Prescriptions for Sheep-Dips approved by the Board for Sheep-Scab.

(Quantities for 100 gallons of bath.)

1. Lime and Sulphur.

Mix 25 lbs. of flowers of sulphur with 12½ lbs. of good quick-lime. Triturate the mixture with water until a smooth cream without lumps is obtained. Transfer this to a boiler capable of boiling 20 gallons, bring the volume of the cream to 20 gallons by the addition of water, boil and stir during half an hour. The liquid should now be of a dark red colour; if yellowish, continue the boiling until the dark red colour is obtained, keeping the volume at 20 gallons. After the liquid has cooled, decant it from any small quantity of insoluble residue, and make up the volume to 100 gallons with water.

2. Carbolic Acid and Soft Soap.

Dissolve 5 lbs. of good soft soap, with gentle warming, in 3 quarts of liquid carbolic acid (containing not less than 97 per cent. of real tar acid). Mix the liquid with enough water to make 100 gallons.

3. Tobacco and Sulphur.

Steep 35 lbs. of finely-ground tobacco (offal tobacco) in 21 gallons of water for four days. Strain off the liquid, and remove the last portions of the extract by pressing the residual tobacco. Mix the whole extract, and to it add 10 lbs. of flowers of sulphur. Stir the mixture well to secure an even admixture, and make up the total bulk to 100 gallons with water.

NOTE.—The period of immersion in these dips should not be less than half a minute.

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* This is a Parliamentary publication, and can be obtained, through any bookseller, from Messrs. Wyman & Sons, Ltd., Fetter Lane, London, E.C., at the price of 3*d*. The volume of Evidence is numbered Cd. 2,259, price 2*s*. 4*d*.

† A copy of the Order can be obtained on application to the Board.

Although the Board have not included in the above-mentioned schedule any preparation containing arsenic, it is not to be assumed from this omission that the Board do not concur in the view that the arsenic dips are thoroughly effective against sheep-scab. The possible danger to human beings attendant upon the preparation of such dips renders it advisable, however, that they should be compounded by qualified persons only.

The Board at the same time recognise that there are a large number of sheep-dips on sale which may be regarded as equally effective against sheep-scab, and they have made arrangements for the examination of any sheep-dips which the manufacturers may submit to them for approval. On being satisfied that a preparation may be relied upon as effective against sheep-scab, the Board will issue their formal approval to the manufacturer with an intimation that he is at liberty to label the preparation to that effect when offering it for sale. Where approved preparations other than those appearing in the schedule are made use of, the instructions issued by the manufacturers as to the amount of dilution and as to the period of immersion should be carefully observed.

Of the two forms of bath—hand and swimming—the latter is greatly to be preferred. The advantages of the swimming bath are: (1) The sheep, being in a natural position, may be completely immersed, even in a poisonous solution, with comparatively little danger; (2) sheep in lamb may be dipped with much less risk; (3) the motion of swimming allows no portion of the fleece to escape contact with the solution; (4) the work is more easily and therefore more effectively performed; (5) a larger number of sheep can be dipped in a given time and with fewer operators.

On pastoral hills, or where the boundary fences are defective, it is difficult, if not impossible, to prevent a certain amount of mixing between sheep belonging to adjacent owners, and it is no easy matter to avoid the risk of attack. On commons the danger of contamination of the flock is still greater. But, with ordinary precautions, scab should be impossible of introduction to a well-fenced farm. These precautions consist in using reasonable care in the purchase of sheep, and in making a point of never bringing fresh sheep on to the ground without first putting them through the dipper. If sheep are exposed at a market, without effecting a sale, the animals should be dipped before being returned to their grazings or mixed with other sheep.

These are safe precautions under any circumstances, and especially so in scab-infected districts.

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BOARD OF AGRICULTURE AND FISHERIES.

The Pear and Cherry Sawfly.

(*Eriocampa limacina*—Cameron.)

Slugworms (Larvæ of *Eriocampa limacina*) upon a leaf.

The extremely repulsive larva of this sawfly is frequently most destructive to pear and cherry trees. It also infests apple, plum, damson and peach trees, and is occasionally seen upon oak, birch, and other forest trees, as well as on some species of thorns. In the dry seasons of 1899 and 1901, cases occurred where nearly all the leaves fell from pear trees in consequence of the continuous attacks of larvæ of this sawfly, which are sometimes called slugworms or snegs.

Heat and drought are, without doubt, favourable to the multiplication and destructive activity of this insect, while cool, showery weather interferes not only with the hatching of the eggs, which are laid upon the upper and under surfaces of the leaves, but also with the growth and health of the larvæ. It is generally found that the larvæ do not cause serious harm in wet seasons.

Life History.

The sawfly itself is harmless. It is not quite a quarter of an inch in length, having a wing expanse of about half an inch. Its body is blackish; its wings are dusky, with traces of a dark band across them, and slightly paler at the tip; its legs are also dark. The fly usually makes its appearance early in June, but sometimes in May; and the female soon proceeds to make an irregular oval slit in the leaf, with

the aid of her peculiar saw-like apparatus, which is somewhat like that of the gooseberry sawfly (*Nematus ribesii*) and many other saw-flies. In this abrasion an egg is deposited ; this can be easily seen on the leaf, as a slight, round spot is formed, in the centre of which there is a transparent skin or film covering the whitish egg. The number of eggs upon one leaf often amounts to twenty or even more, but as a rule not more than five or six larvæ, usually only one, are seen upon a leaf. The egg is always laid from the under surface of the leaf.

The larva, which is hatched in from seven to twelve days, emerges from the upper surface of the leaf, and is at first white ; in a day or two it becomes green, and soon afterwards a dark green slime exudes from and covers its body. This exudation is evidently designed to protect the insect from the influences of weather and parasites, to which it is fully exposed upon the upper surface of the leaf. The larva is particularly ugly at this period of its life, being dark green or almost black and slimy, the under part of the body paler ; while its head and the upper part of its body are much broader than the lower part, which tapers towards the end. At this stage it very much resembles a malformed slug or a tadpole. It has seven pairs of "sucker" feet on its abdomen, three pairs of distinct feet upon the thorax, and a pair of very rudimentary "sucker" feet at the end of its body. But with all these feet it moves very slowly, being slug-like in its movements. When it is full grown it is close upon half an inch in length, and at about the end of a month, after five moults or castings of skin, it loses its slug-like appearance and slime, and assumes an orange yellow or buff colour. After this change it crawls down the tree, or falls to the ground, and develops into a dark coloured pupa in a little cell made of silk and earth. There are two or more broods during the year. The pupal stage lasts two weeks during the summer. The winter is passed in the larval stage in a case of earth beneath the trees, the grub pupating in the spring. The larvæ of this sawfly are found upon the leaves of fruit trees even as late as October.

Unlike most other larvæ and caterpillars, this slugworm eats away the upper surface of the leaves ; it clears away the parenchyma, or soft tissue, between the ribs and nerves, leaving them bare as the framework of a parasol, but the lower layer of the leaf always intact. At first the leaf gets eaten in patches, but ultimately every particle of green is devoured. When these larvæ are present in great numbers the noise they make in feeding is said to resemble the falling of drops of rain on the leaves. They are very sluggish, and their sluggishness is only surpassed by their voracity. A severe infestation of them entirely prevents

the production of fruit, and even a slight attack has a marked effect on the crop of pears, which cannot come to perfection if the leafage of the tree is injured.

This insect does much harm to pear and cherry trees in America. As early as 1797, according to Harris, the larvæ of this sawfly caused great injury. "Small trees," he says, "were covered with them, and their foliage entirely destroyed, and even the air, by passing through the trees, became charged with a disagreeable and sickening odour given out by these slimy creatures." This has also been noticed in England. In California it is often very troublesome, especially to pear trees. Professor Saunders states that in 1874 this sawfly was unusually abundant in Ontario, in many cases destroying the foliage so thoroughly that the trees looked as if they had been scorched by fire. This sawfly was at one time called *Selandria cerasi* in America. It is also well known in France and Germany.

Methods of Prevention and Remedies.

As it is clear that the pupæ of this sawfly are in the earth immediately under the fruit trees upon which the larvæ have been feeding, it is desirable to dig the ground all round the trees in the early spring, and to hoe it with pronged hoes so that the earth may be broken up finely. Quicklime should then be put on and hoed in. In gardens, after the digging and hoeing, it would be useful to beat down the earth in the spring with a shovel in order to prevent the flies from coming up. Soot and lime should be put under the trees in the autumn in moderate quantity and evenly distributed, as it has an injurious effect upon the larvæ when they fall to the ground.

Trees that have been severely attacked in gardens and orchards might have poultry penned round them in the late autumn or winter.

Paris Green has been used as a remedy for these slug-worms. It poisons their food, and is used extensively in the United States for attacks of the sawfly larva and many other insects. It should be applied in the proportion of 1 lb. of Paris Green to 200 gallons of water, carefully mixed and distributed all over the leaves as evenly as possible. Paris Green can be obtained in the form of paste (Blundell's paste), when it can be much more easily mixed with water than the powder, which is so fine that the least breath of air blows it over the face and clothes of those who are using it.

The most useful insecticide is either hellebore wash or arsenate of lead. These are prepared as follows :—

Hellebore wash.—1 oz. of fresh hellebore, 3 gallons of water, 2 ozs. of flour. This must be constantly stirred.

Arsenate of lead.—Dissolve 4 ozs. arsenate of soda (40–50 per cent. strength) in a little water; then dissolve 12 ozs. white commercial acetate of lead in water; then add the dissolved arsenate of soda to 100 gallons of soft water, and then mix well and add the dissolved acetate of lead and thoroughly mix. To this add 2 lbs. treacle.

These washes are poisonous, so must not be used on ripe or ripening fruit for four weeks before it is gathered.

These remedies would be applicable to pear, apple, plum, and damson trees. It would be more difficult to apply them to cherry trees, as the fruit is often nearly ripe when the attack of the insect is first noted. After the cherries are picked the trees should however be dressed to prevent the larvæ from devouring the foliage and weakening the trees for the next season.

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BOARD OF AGRICULTURE AND FISHERIES.

Destruction of Charlock.

This weed, which is common in cultivated fields throughout the whole of Great Britain, is known under a variety of names, such as karlock, yellows, yellow weed, skellock, runches, wild mustard (*Brassica Sinapis* Vis., *B. Sinapistrum* Boiss., *Sinapis arvensis* L.). In general appearance it closely resembles the turnip, to which, in fact, it is very nearly related. As in the case of other plants of the same family, charlock seed contains a large amount of oil, and this is at least partly accountable for the persistent vitality often exhibited by this seed. Land that has been under grass for many years may thus, when broken up, show an abundant growth of this weed, and the same state of things not unfrequently attends extra deep cultivation, and the consequent disturbance of dormant seeds.

Everything considered, charlock is perhaps the most troublesome weed with which the farmer of arable land has to contend. In corn crops its growth is often so rank as to seriously reduce the yield of grain. In root and bean crops the weed can be more easily dealt with ; but here also it often proves very injurious, and especially so when the conditions of the weather, or scarcity of labour, prevent its timely eradication. As a rule it is not conspicuous amongst rotation grasses or clover, and it is practically absent from permanent grass land.

The injury induced by charlock is partly direct and partly indirect. It competes with crops for light and air ; that is to say, it overgrows more or less completely, and smothers, other plants with which it is associated. It also robs crops of a part of their nutriment, and prevents their deriving full benefit from the moisture of the soil. But in other ways—though more indirectly—this weed may be the cause of much loss. The turnip "fly," for instance, would be unable to exist in early summer, when the cultivated crops on which it preys are, for the most part, absent from our fields, did if not find weeds like charlock to supply it with food ; and similarly the turnip-gall weevil is often found in the roots to

charlock. Then, again, the microscopic fungus that causes finger-and-toe finds a congenial habitat in the roots of this plant, which may thus do much to carry the disease over the years that separate two turnip crops.

In the case of root crops reasonable attention in the matter of horse and hand hoeing may usually be depended on to keep charlock in check. It is when present in spring corn crops that it is most troublesome. Various expedients have been tried with the view of curtailing the development of the weed. If the field be harrowed, and the sowing of the grain be somewhat delayed, a large proportion of the charlock seed will be induced to germinate, and the resulting plants may be afterwards destroyed by harrowing. Hand and horse hoeing may be practised—providing the corn has been drilled, and has not been sown down with grass or clover seeds. At a later stage of growth the flower heads may be more or less effectively knocked off by means of a special machine, the use of which diminishes the formation of seed, but does little to mitigate injury to the corn crop immediately concerned.

In 1897 attention was called to the possibility of getting rid of charlock in corn crops by means of the application of certain solutions which, it was contended, could destroy the weed without injuring the cereal. The reason for this "selective power" of such solutions is said to lie in the fact that the leaves of charlock, being rough and horizontally disposed, catch and retain the poison, whereas the leaves of cereals, being erect and smooth, allow liquids to run off, and so escape injury. During the past few seasons this method of dealing with the pest has been extensively tested in Great Britain, and, as a whole, the results have been successful. The substances chiefly tried have been copper sulphate and iron sulphate, and good results have been got with both. Although the former costs much more than the latter, the solution of iron sulphate must be used so much stronger than the other that the difference in the cost of material is less per acre than would at first sight appear. Moreover, copper sulphate deteriorates less by keeping, is more easily manipulated, and does less injury to the clothes of the workmen.

Experience indicates that good results will, as a rule, be got by dressing an acre with, at most, 40 gallons of a 4 per cent. solution of copper sulphate, or with a similar quantity of a 15 per cent. solution of iron sulphate. To make the former, dissolve 16 lbs. of copper sulphate, in 40 gallons of soft water ; while, in the latter case, 60 lbs. of iron sulphate are required in a similar quantity of water. Somewhat better results will be got by dressing an acre with 16 lbs. of copper sulphate dissolved in 60 gallons of water—

thus making a $2\frac{2}{3}$ per cent. solution—but although this entails no extra outlay for material, it implies an increased expenditure on account of labour. Then, again, in place of applying 40 gallons per acre of a 4 per cent. solution at a single operation, superior results may sometimes be got by applying 30 to 40 gallons per acre of a 2 per cent. solution at a somewhat early stage of the growth of the weed, and a similar quantity ten days or a fortnight later. As compared with a single dressing this involves no extra expenditure on material, but it entails the application of about twice as much water, and the crop suffers more from mechanical injury. Good results have occasionally been got with weaker solutions and with smaller quantities than those indicated, but on the whole those recommended above have proved most effective.

The quantities indicated have been found to do no permanent harm to cereals, or to clover or grass occupying the ground along with the corn crop, but solutions for application to beans or peas should be considerably weaker than those used for corn crops.

A convenient method of procedure is to have two 40-gallon barrels in use, so that while the contents of one are being distributed, the other may be used for the preparation of a fresh quantity of solution.

It may be noted that certain weeds closely allied to common charlock—especially wild radish, or white charlock, and smooth leaved-charlock—are not unfrequently met with, and these do not readily yield to treatment. Other weeds such as docks and thistles are more or less crippled, without being destroyed by the solutions.

To obtain the best results it is necessary to attend to the following points :—

1. The weed should not exceed three inches in height at the time of spraying, though fair success has sometimes attended treatment almost up to the time of flowering.

2. The solution must be made with clean, and, if possible, soft water, and the vessels used in the process should be of wood.

3. The material, especially copper sulphate, should be bought under a guarantee of purity of 98 per cent. It should be obtained powdered, not in crystals. This facilitates solution.

4. The solution must be applied by means of a machine that generates a fine spray under air pressure. A hand machine of good construction will dress three or four acres in a day, while a horse machine will cover nearly ten times as much. The latter distributes the solution more thoroughly and equally.

5. Rain immediately after spraying will interfere with success, and the calmer the weather the more evenly and effectively is the solution distributed. Moderate dampness of the crop at the time of spraying is no disadvantage, and better results will be got in dull weather than in bright sun.

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BOARD OF AGRICULTURE AND FISHERIES.

White Root Rot.

(*Rosellinia necatrix.*)

The destruction of fruit trees due to rotting of the root, caused by fungi, is very prevalent, and has been recorded from every part of the world where such trees are cultivated. Wild trees such as cherries, crabs, bullace, &c., growing in woods and hedgerows are also attacked, and in some instances it has been proved that the disease has passed from such wild trees to cultivated plants.

Although the disease has been mostly observed on fruit trees belonging to the order *Rosaceae*, it is by no means entirely confined to such. In Germany it has been met with on the roots of vines, fruit-trees, potatoes, beans, beet, young maples, oaks, beeches, pines and spruces. It also attacks and destroys very many kinds of weeds, and by thus being able to obtain food from the living roots of such a varied assortment of plants, the fungus when once introduced into a district spreads with great rapidity in every direction, travelling from root to root. As the fungus remains entirely underground during its progress, the true cause of the disease is in many instances not suspected.

The earliest indication of the disease is the wilting of the leaves; in the case of annual plants this is followed by the drooping of the stem, after which the plant quickly dies. If the root is examined at this stage it will be found to be covered with a white fluffy coating of fungus spawn or mycelium. This mycelium does not appear able to obtain food from a dead root, but white strands spread in all directions in the soil in search of other living roots.

When the root of a fruit tree is attacked, the end is not so sudden, but quite as certain, if proper treatment is delayed. During the first year of attack the wilted foliage falls early in the season, resulting in imperfectly matured wood

1. A diseased root showing mycelium ascending the trunk under the bark.
2. Fruit of fungus on portion of a dead root.

During the second season there is usually a profusion of blossom with only a scanty development of foliage, which again wilts and falls to the ground quite early in the season. The fruit does not set, and the whole tree presents a distinctly sickly appearance. In the third year of disease the tree usually dies.

If the soil is carefully removed from the root of a diseased tree, patches of variable size of a snow-white mycelium will be observed on its main branches, and if the tree has been diseased for some time, white strands of mycelium will be found spreading in all directions in the soil, which has a strong mouldy smell.

If the bark of the lower part of such a diseased stem is removed, these flakes of mycelium will be found between the bark and the wood, and spreading up the trunk from the diseased root.

Two or three kinds of fungi, in addition to the one named above, cause root-rot; the general appearance of the disease and the treatment is the same for all.

During the early stage of the disease the mycelium is snow-white, eventually becoming grey in colour, especially where it grows round the collar of the trunk, or on portions of roots exposed to the light.

Various simple forms of fruit are produced by the fungus while the tree it is attacking is yet alive, but it is only after the tree is dead and its wood thoroughly dry and decayed that the highest form of fungus fruit, under the form of dense clusters of minute, black, bead-like bodies, is produced.

Preventive Measures.

If wilting of the leaves suggests root-rot, an examination of the root should be made at once; if white mycelium is found, as much of the root as possible should be carefully exposed, and the branches covered with powdered sulphur; some of this substance should also be mixed with the soil used for filling in, which should be fresh and free from mycelium, and not the old infected soil removed from the root. The infected soil should be sterilized by mixing with quick-lime or gas-lime.

Diseased trees or portions of a diseased orchard should be isolated by digging a narrow trench about a foot deep round the infected part. This prevents the underground spread of

the fungus to adjoining healthy trees. The removed soil should be thrown on to the diseased area inside the trench.

Stagnant water in the soil favours the disease, good drainage is therefore requisite.

Weeds of all kinds should be kept down, and if the disease is noticed amongst wild trees, blackthorn, bullace, cherry, &c., the trees should be isolated, removed and burned.

It is very important to collect all fragments of roots from the soil when diseased plants are removed, and to sterilize the soil.

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BOARD OF AGRICULTURE AND FISHERIES.

The Small Ermine Moths (*Genus, Hyponomeuta*).

H. padella L.

Moth, twice natural size; larvæ and web about natural size.

Identification.

The genus *Hyponomeuta* belongs to the *Tineina*, a group of small moths. The genus, though containing a small number of species, has a widespread distribution. There is considerable confusion in the literature, in the description, and in the naming; the confusion arising from the fact that (1) the moths of the different species are very like each other; (2) the caterpillars of the different species have also a great resemblance to one another; (3) the caterpillars of more than one species may be found on the same food plants; and (4) the life history has in each case a close resemblance.

Generally it may be said that the moths are small, their fore wings are white or lead-grey or slate-coloured, with black dots (hence the name Ermine Moths); and the thorax has usually also similar marks. The hind wings are darker in colour and have long fringes. The caterpillars live together socially on the twigs in gauze-like spun webs, and under cover of these webs pupation takes place in cocoons shaped like oat grains.

The caterpillars of two or three species are destructive to the leafage of the Spindle tree (*Euonymus Europaeus*), and in addition in Britain there are three species harmful to fruit trees, viz., *Hyponomeuta padi*, Zell (*H. euonymella*, L.), whose caterpillars feed chiefly on bird cherry; *Hyponomeuta padella*, L. (*H. variabilis*, Zell), whose caterpillars feed on plum, hawthorn, sloe, medlar, apple, mountain-ash and other *Pyrus* species; and *Hyponomeuta malinella*, Zell, whose caterpillars feed on the apple.

H. padi. This moth is the largest of the three. It measures in length 9 mm. (roughly, there are 25 millimetres in an inch) and 25 mm. in stretch of wings. The head is white, and the upper surface of the fore wings is also white with five longitudinal rows of black dots. The hind wings are dark grey. The caterpillars are yellowish in colour, with black heads, and may measure when full grown 20 mm.

H. padella measures 8 mm. in length, and 22 mm. in stretch of wings. Head white; fore wings white-grey with three longitudinal rows of black dots; the abdomen ash-grey with whitish rings. The caterpillars have black heads, they are greyish in colour with conspicuous dark-coloured spots, and measure 14 mm. in length. The pupa is yellow in the middle, the head and wing-cases are black-brown, and the cocoons which hang singly in the web are very delicate.

H. malinella is 7 mm. long, and 17 mm. to 19 mm. in spread of fore wings. The fore wings have three longitudinal rows of black dots. The caterpillars have black heads and are yellowish in colour, with slight variations at different ages. The cocoons are not delicate as in *H. padella*, but they are opaque and hang together in bundles.

Life-History.

The moths are found flying in July and August when the eggs are laid on twig and bud in larger or smaller collections. The eggs lie under cover of a glutinous substance which dries into a protecting case. The eggs may hatch in the autumn of the same year, but the caterpillars on account of their smallness are not noticed. They do no damage until the next spring when they may enter buds, feeding on blossom and mining into young leaves. Soon attaining strength in May and June the caterpillars feed externally on the leaves and spin their webs. The web-

making continues as the larvæ move to fresh feeding places. The feeding caterpillars are social, living together in numbers in a web or nest.

In cases of bad attacks the trees may be almost stripped of foliage, and rendered unsightly by the dirty coloured ragged webs. The caterpillars when full-fed become pupæ in cocoons, a number of these being present in a web; the pupal stage lasts a fortnight.

Infested trees are greatly weakened by the loss of foliage, and although after the caterpillars have stopped feeding the trees produce a fresh set of leaves, there is bound to be shortage of the fruit crop. In the case of the apple the young fruits fall away when the foliage is stripped.

Preventive and Remedial Measures.

1. Shake the moths down from the trees on which they rest during the day, on to cloths spread below to catch them. The moths rest with their narrow wings rolled round the body and they are sluggish.

2. Handpicking (if practicable) and cutting off of infested twigs, and crushing or burning the webs so as to kill the contained brood.

3. If water under high pressure from a hose can be applied the colonies may be effectively destroyed.

4. Spraying with paraffin emulsion. The earlier this is done the better so that the webs may not be so numerous or so thick, as they are difficult to penetrate. The Board know of one case in Perthshire where, in an extremely severe infestation, the proprietor dissatisfied with the result of a paraffin spray, made up a strong solution of an arsenical sheep dip, and by this means killed thousands of caterpillars. The caterpillars that had not been killed, or which on disturbance had let themselves down from the web by their threads, collected at the foot of the trees and were easily destroyed. Great care however had to be exercised as any leaves touched by the material turned black and dropped off.

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BOARD OF AGRICULTURE AND FISHERIES.

Workmen's Compensation Act, 1900.

(63 & 64 Vict. c. 22.)

The object of the Workmen's Compensation Act, 1900, is to extend to workmen in agriculture the benefits of the Workmen's Compensation Act, 1897. If any personal injury by accident arising out of, and in the course of, employment in agriculture is caused to a workman, his employer will be liable to pay him compensation, subject to certain provisions referred to below. No employer is liable to pay compensation under the Act unless he habitually employs one or more workmen in agriculture; but if this condition is fulfilled, the employer will be liable to pay compensation to all workmen employed by him in agriculture, whether such employment is continuous or casual.

The precise meaning of the word "habitually" in this Act is not very clear, but the mere fact that the employment by any person of agricultural labour is not continuous throughout the year would not seem to exempt such person from liability under the Act, and it is therefore prudent for any person employing agricultural labour, whether casually or continuously, to insure against liability in respect of injuries to all persons so employed by him.

The term "workman" includes every person who is engaged in agriculture, whether by way of manual labour or otherwise, and whether his agreement is one of service, or apprenticeship, or otherwise, and is expressed or implied, is oral or in writing.

The expression "agriculture" includes horticulture, forestry, and the use of land for any purpose of husbandry, inclusive of the keeping or breeding of live stock, poultry, or bees, and the growth of fruit and vegetables. It should be observed that this definition is very wide in its terms, and that the Act, therefore, imposes a liability not only upon farmers, and other persons engaged in agriculture, in the more limited and ordinary sense of that expression, but also upon many other persons, as, for instance, persons who habitually employ one or more gardeners or others in garden-work, whether in the way of trade or business or otherwise, and whether the gardens are attached to houses or not.

Where a workman is employed by the same employer mainly in agriculture, but partly or occasionally in other work, the Act applies also to the employment of the workman in such other work.

The amount of compensation payable under the Act is regulated by the following provisions of the Act of 1897 :—

(*a*) where death results from the injury—

(i) if the workman leaves any dependants wholly dependent upon his earnings at the time of his death, the amount is to be a sum equal to his earnings in the employment of the same employer during the three years next preceding the injury, or the sum of one hundred and fifty pounds, whichever of those sums is the larger, but not exceeding in any case three hundred pounds, provided that the amount of any weekly payments made is to be deducted from such sum, and if the period of the workman's employment by the said employer has been less than the said three years, then the amount of his earnings during the said three years is to be deemed to be 156 times his average weekly earnings during the period of his actual employment under the said employer;

(ii) if the workman does not leave any such dependants, but leaves any dependants in part dependent upon his earnings at the time of his death, the amount is to be such sum, not exceeding in any case the amount payable under the foregoing provisions, as may be agreed upon, or, in default of agreement, may be determined, on arbitration, to be reasonable and proportionate to the injury to the said dependants; and

(iii) if he leaves no dependants, the amount is to be the reasonable expenses of his medical attendance and burial, not exceeding ten pounds;

(*b*) where total or partial incapacity for work results from the injury, the compensation is to be a weekly payment during the incapacity after the second week not exceeding fifty per cent. of his average weekly earnings during the previous twelve months, if he has been so long employed, but if not, then for any less period during which he has been in the employment of the same employer, such weekly payment not to exceed one pound.

In fixing the amount of the weekly payment, regard is to be had to the difference between the amount of the average weekly earnings of the workman before the accident and

the average amount which he is able to earn after the accident, and to any payment not being wages which he may receive from the employer in respect of his injury during the period of his incapacity.

Any weekly payment may be reviewed at the request either of the employer or of the workman, and on such review may be ended, diminished or increased, subject to the maximum above provided, and the amount of payment is, in default of agreement, to be settled by arbitration.

Where any weekly payment has been continued for not less than six months, the liability therefor may, on the application by or on behalf of the employer, be redeemed by the payment of a lump sum, to be settled, in default of agreement, by arbitration, and such lump sum may be ordered by the arbitrator to be invested or otherwise applied as above mentioned.

An employer is not, however, liable to pay compensation in respect of any injury which does not disable the workman for a period of at least two weeks from earning full wages at the work at which he was employed.

If it is proved that the injury to a workman is attributable to the serious and wilful misconduct of that workman, any compensation claimed in respect of that injury will be disallowed.

To meet cases of sub-contracting the new Act specially provides that where an employer agrees for the execution of any work in agriculture by or under a sub-contractor, such employer shall be liable to pay compensation to any workman employed in the execution of the work, whether the workman is entitled to obtain it from the sub-contractor himself or not; but, if the workman takes advantage of this provision, the employer so made liable is entitled to be indemnified by any other person who would have been liable independently of this provision. Examples of such sub-contracting in agriculture are cases where work is done through a ganger, or where crops are cut for the occupier by a farmer with his own men and implements.

These enactments as to cases of sub-contracting do not apply where the sub-contractor's work is merely ancillary or incidental to, and is no part of, or process in, the trade or business carried on by the person who entrusts the work to the sub-contractor; and in cases in which the sub-contractor provides and uses machinery driven by mechanical power for the purpose of threshing, ploughing, or other agricultural work, he and he alone, is liable to pay compensation to any workman employed by him on such work.

In cases where damages in respect of an injury are recoverable from some person other than his employer, the workman may, at his option, proceed either at law against that person to recover damages, or against his employer for compensation under the Workmen's Compensation Acts, but not against both; and if compensation be paid under the

Acts, the employer is entitled to be indemnified by the said other person.

All questions as to compensation under the new Act are, in case of difference, to be settled by arbitration in accordance with the Workmen's Compensation Act, 1897.

In view of the liability attaching to farmers and others under the above-named Acts, the Board of Agriculture desire particularly to call attention to the fact that many of the leading insurance companies are now issuing Farmers' Insurance Policies which provide for the payment of legal compensation on the basis of the Workmen's Compensation Act for all accidents occurring to workmen in the course of employment in agriculture; and which cover, in addition, the existing liability of farmers in connection with accidents to their servants under the Employers' Liability Act, 1880, the Fatal Accidents Act, 1846, and at Common Law. The annual premiums charged for these policies range at the present moment from about 5*s*. for every £100 of wages paid. In cases in which it is desired that the policy should cover compensation for the first two weeks' disablement (which is not provided for by the Workmen's Compensation Acts) the premiums range from 6*s*. per £100 of wages paid.

Policies are also issued, at slightly higher rates, which not only afford protection against the legal liability of employers, but also provide compensation for accidents where there is no legal liability; in the latter case, however, the weekly payments in cases of disablement are limited by some companies to 26 weeks, and the amount payable at death to £100.

In taking out a policy insurers should make careful inquiry as to the extent of the liability covered by the policy.

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BOARD OF AGRICULTURE AND FISHERIES.

Favus in Poultry (*Tinea favosa*).

Fig. 1. Portion of skin of fowls' neck affected with favus.

While many fungi cause disease in plants some set up disease in animals. Ringworm and Favus are two such diseases, the disease-causing fungi consisting of extremely delicate threads which prey on the live tissue of the host.

The disease Favus is produced by the minute parasitic fungus known scientifically as *Achorion Schœnleinii*. This fungus attacks the comb and wattles of birds, and spreads from the naked parts of the head to parts covered by feathers, *e.g.*, the neck, and the parts in the neighbourhood of the cloaca. Sometimes one side only of the neck may be affected, becoming quite deplumed, whilst the other shows no signs of invasion; but, as a rule, it is the comb that suffers first and most from the attack. Favus is common to man, the cat, dog, and rabbit, and is particularly prevalent in rats and mice. The disease is rarer in our country on man than it used to be, and is almost exclusively confined to the poorer classes where conditions have been dirty and insanitary. The disease may be contracted from patients (man or other animals) that are being treated or experimented with.

Favus is very destructive in poultry-yards, and, being highly contagious, often spreads with great rapidity. A single diseased cock soon contaminates the whole run, and several outbreaks have been traced to a new male bird from an affected yard.

The first signs of an attack of favus are small, pale, irregular, cup-like spots on the comb or wattles, generally appearing on the comb first. These spots grow together, and sooner or later form a confluent covering of a dirty yellowish-grey substance, which is often arranged in concentric layers. These crusts grow thicker. When they are present on the comb or wattles there may be a complete and rapid disappearance of the malady; but when the feathered areas become invaded the disease is more persistent. The breast sometimes, and the rump especially, may be denuded by this fungus, which, when present on the feathered parts, usually ends fatally unless treatment is resorted to. The feathers become erect and dry, and somewhat brittle, and fall off, leaving the naked skin covered with dull yellowish grey crusts, showing here and there somewhat funnel-shaped depressions from which the feathers have fallen. The fungus may easily be observed by scraping the diseased surface or the skin under the crusts, and examining the scraping under the microscope. It will then be seen to consist of a number of fine threads (the mycelium), and numerous spores, sometimes nearly the whole mass being composed of the latter. To examine the fungus, the *débris* from the skin and crusts should be put on a slide, and then moistened with distilled water and a little acetic acid.

Nearly all breeds seem equally susceptible, but the disease does not appear to have occurred in Indian Game; it is said that fowls of Cochin China descent are most liable to it.

Care should be taken in handling patients, as the disease can be transmitted to man, on whom it is not so amenable to treatment as in birds. The fungus has powers of penetration, but certainly far the greatest risk of infection is run if the skin or surface is abraded or wounded.

Treatment.

The treatment consists in bathing the invaded parts with warm water and soft soap, and then applying some ointment to destroy the parasite. Nitrate of silver well rubbed into the comb and wattles has been found of great benefit. A correspondent of the Board of Agriculture and Fisheries recommends an ointment of 5 per cent. of the nitrate of silver in soft paraffin (vaseline) for the purpose. Red oxide of mercury one part, to lard eight parts, has proved an excellent remedy if used for several days. Another correspondent of the Board advises "powdered zinc, copper, and iron rubbed on the damp comb." Favus has yielded readily to treatment with a 10 per cent. solution of carbolic acid. *Thymol* has also been mentioned as a possible remedy for favus, as it has been used successfully in treating ringworm, a somewhat similar parasitic disease in the human subject.

In any case, it is most essential to well foment the diseased parts previously to applying the ointment, and to remove as far as possible all the favic crusts with a blunt knife. One cannot be too careful in examining a fresh bird before turning it into the run, which should not be done if any signs of "favus" are noticed upon it.

Fig. 2. The filaments and spores of *Achorion Schœnleinii*. (After Neumann.)

Should the disease appear, the bird should be isolated, or it may spread the disease. It should be treated at once, as when the parasite reaches the feathered tracts it is much more difficult to eradicate.

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BOARD OF AGRICULTURE AND FISHERIES.

Currant Aphides.

(*Rhopalosiphum ribis*, Linn., and *Myzus ribis*, Linn., &c.)

During 1901 currant bushes were considerably damaged by Aphides or Plant Lice. In some districts the bushes were quite ruined, the leaves turned brown and shrivelled up, and the fruit fell off, the bunches "shanking" in consequence of the abnormal presence of these pests. The rapid increase of the "Plant Lice" was due to a long spell of dry, warm weather, so favourable to the development of these insects, so detrimental to the development of the fruit and health of the bushes. Aphides are usually more or less prevalent on currants, and are always liable under certain climatic conditions, such as existed during June, 1901, to increase to an injurious extent.

Currant bushes should therefore be washed early in the year just as regularly as apple, plum, and pear trees. Four species of Aphides occur on currants, two more or less confined to the currant and other *Ribes*, *e.g.*, gooseberry, namely, the Currant Blister Aphis (*Rhopalosiphum ribis* of Linnæus) and *Myzus ribis* of Linnæus.

The two true currant species only need be mentioned. They work in a slightly different way. One, *R. ribis*, produces reddish, reddish-brown, or yellow blister-like galls on the surface of the leaves, whilst *Myzus ribis* often causes the leaves to curl up, especially on the top shoots. Both species are equally difficult to destroy after they commence to breed in numbers, owing to their being hidden, and more or less protected in the hollows of the blisters and under the curled-up leaves. The galled patches are chiefly noticed on the upper surface of the leaf, where they are blister-like; below they are concave. In this cavity the Aphides live and breed, increasing the area of the diseased patch as they develop. Numerous blisters may be formed on one leaf, varying in size from one-fourth to nearly an inch in length. The leaves so attacked shrivel away, but the fruit often falls owing to loss of sap long before the leaves die. Neither of these Aphides is said to form much "honey-dew," hence the diseased appearance of the leaf is often not noticed as being of insect origin during the early stages of the

attack unless an examination has been made of the under surface. Later on "honey-dew" becomes abundant, being especially formed by the leaf-curling species; on black currants the "honey-dew" often gives a shiny and sticky appearance to the whole bush.

The insects spread chiefly by means of winged generations, which appear every now and then, flying from bush to bush, and there setting up fresh areas of disease. These winged generations may occur as early as the middle of May, but usually not until June.

Life-history.

The appearance and habits of the two currant Aphides are different, but their life-histories are very similar.

(I.) *Rhopalosiphum ribis*, L.—The wingless viviparous female, or "Mother Queen," is shiny green, mottled with darker green; legs, honey-tubes, and antennæ pale green; eyes, red. In form it is oval and convex, and slightly larger than the following species (II.); the body being one-tenth of an inch long. The wingless females are found on the under-surface of the leaves and cause the red, orange, and yellow blisters. They appear first of all in April, and occur continuously until July and even August. Every now and then the lice to which they give rise turn into so-called pupæ which are characterised by rudiments of wings appearing as wing buds.

The pupa is green, and does not, apart from the wing cases, differ much from the wingless female or larva. The winged viviparous female, which arises from the pupa, is yellowish-green with black head and antennæ; the thorax is black with a yellow band in front; the abdomen is bright yellowish green, with dark spots and patches on the back and sides; yellow honey-tubes, swollen towards the apex; legs ochreous with the joints and the feet black. These winged females fly from bush to bush. In the autumn or late summer males and egg-laying females are formed; the egg-laying female, after being fertilised, deposits a few brown elongated eggs on the last year's growth of a twig just under the broken rind or upon it. Here the eggs remain all the winter. This aphis, besides feeding on the red, black, and white currant, also attacks the gooseberry, and it has been found in the Guelder Rose, the Nipple Wort, and the Sow Thistle.

(II.) *Myzus ribis*, Linn.—This plant-louse can easily be distinguished from the former, with a lens, by its olive, not black, head, and its black honey-tubes and irregularly black ornamented abdomen in the winged female. It occurs from April to August, especially in the black currant and gooseberry, but also on the red currant; it is said to cause blisters

similar to (I.). It often causes the leaves at the apex of the shoots to curl and twist up.

The wingless female, which appears in the spring, is shiny yellowish-green, with dark green mottlings, elongated oval in form, and with curious hairs in front; the honey-tubes and legs are pale green, and the eyes bright red. The larvæ are pale green. When the leaves lose their sap they turn to pupæ, and then to winged females. The pupa of this species is shiny yellowish-green, with two brown spots on the back of the head. The winged viviparous female is bright green, with pale olive head, brown thorax with an olive band across it, irregular transverse bands and spots on the abdomen, and four or five dark lateral spots; the deep olive-green to black honey-tubes are cylindrical in form, and the deep green legs have olive feet. Towards July many leave the currants, but as in the former species some always remain, and give rise to egg-laying females and males, the former depositing their long brown eggs under the exfoliated rind, attaching them to it by a gummy excretion; the eggs hatch in the spring, when they give rise to larvæ, which soon grow into the "Mother Queens." The wingless female is smaller than in the former species, being little more than one-twelfth of an inch long. It also occurs on the gooseberry, and it has been noticed to curl up the leaves and deform the shoots more often than the former species.

Natural Enemies.—The larvæ and adults of the two-spotted Lady Bird are often to be found feeding amongst the colonies of lice, and do inestimable good in keeping them in check. Larvæ of several species of Hover Flies also feed on them, their leech-like green or dull red larvæ living amongst the lice in the blisters or curled leaves.

Prevention and Treatment.

Black currants should be cut very hard in the autumn after an attack, and the strippings carried away and burnt. By so doing many eggs will be destroyed. Probably some benefit would be derived by the winter washing with caustic alkali wash.

Caustic alkali wash is prepared in the following way:—Dissolve 1lb. of caustic soda and 1lb. of carbonate of potash separately in water, then mix the two together and add to 10 gallons of soft water; then add to this ½lb. of dissolved soft soap (Chiswick). Spray over the bushes about February.

When Aphides are present on the bushes it is most important to *spray early in the year*, directly the lice are seen, that is before the blisters appear or the leaves become

curled up; the lice can then be far more readily reached by the spray, than later in the year.

The most successful spray for plant lice is paraffin emulsion, which consists of paraffin, 2 gallons; water, 1 gallon; and soft soap, ½ lb. The method of preparation is as follows:—Dissolve the soap in boiling water, and whilst the mixture is still boiling add it to the paraffin, and then churn very thoroughly until a butter-like mass results. This is the stock which will keep for a long time. When required for use, dilute some with 10 times its bulk of water, but the amount of dilution in different cases depends on the tenderness, vigour, or hardiness of the plants at the time of spraying.

The development of plant lice is favoured by dry and hot weather, and swilling with ordinary water is always beneficial in such conditions.

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BOARD OF AGRICULTURE AND FISHERIES.

Tent Caterpillars.

THE LACKEY MOTH (*Clisiocampa neustria*, Linn.) and THE BROWN TAIL MOTH (*Porthesia chrysorrhœa*, Linn.).

Two species of so-called "Tent Caterpillars" are frequently found on various fruit trees, especially on the apple, plum, and pear. By far the commonest and most destructive is the Lackey Moth Caterpillar (*Clisiocampa neustria*). But in parts of England, notably districts in Kent, the somewhat local Brown-Tail Moth (*Porthesia chrysorrhœa*) does almost as much harm in some seasons. The caterpillars have done considerable damage to apple and plum orchards in some years in parts of Kent. These two insects are called "Tent Caterpillars" on account of the larvæ forming tent-like nests of silk on the trees, in which they live during their early existence, and beneath which they shelter during wet weather and at night when they are more mature.

The damage caused by these two larvæ can easily be prevented, and even when they have a considerable hold on the orchard they can be remedied to some extent by spraying.

As there is some difference in life-history as well as in appearance between the two species, they are best considered separately as far as their natural history goes; prevention and treatment are the same for both species.

I.—THE LACKEY MOTH.

The Lackey Moth is widely distributed over the south, west, and middle of England, but is by far more abundant and destructive in the south and west than in other parts. It does not occur further north than York, where it is usually rare. Always more or less prevalent in the south, at certain times it occurs in greater abundance, and apple and pear orchards are sometimes stripped of every vestige of foliage by the caterpillars. It is more abundant in France than elsewhere; there being laws compelling growers to cut off and destroy the "tents" formed by the larvæ.

The moth is very variable in colour and size, and measures about an inch in expanse of wings in the male, and an inch

and a half in the female. The fore wings are a rusty reddish-brown, yellowish-brown, ochreous or brick-dust red, with two pale or dusky brown transverse lines across them, the space between the two bars being often more deeply coloured than the rest of the wing; the hind wings are the same tint as the fore, but often a little paler; the thorax and abdomen are densely scaly. The adult may be taken on the wing at dusk in July and August, and even as late as September.

The eggs are deposited in autumn in rings on the smaller shoots of the fruit trees, each ring containing from forty to over two hundred eggs. These remain on the trees all the winter, and, being greyish-brown in colour, are readily seen on the dark ground-colour of the twigs, and are thus well-known objects in an orchard.

About the end of April they hatch. The young larvæ are almost black at first, and more or less hairy. Very soon they commence to form a fine web, enclosing a few leaves, and beneath this little tent of silk they continue to feed for some time. As they grow the silken house is enlarged, until in some large colonies it may reach nearly a foot in length. At first the larvæ feed entirely under the tent, but as they grow they spread out over the trees, and eat off the leafage and blossom, returning to the web at night and in wet weather. They become brilliantly-coloured as they grow, being bluish-grey, with two black spots on the segment next the head, and two also on the bluish-grey head; three orange-red stripes along each side, and between the two lowest of these is a broad blue stripe with little black specks, these brilliant lines being separated by black and black spotted with blue, and a white stripe down the back with a narrow black line on each side; the whole larva is covered with rather rusty hairs, darker above than at the sides. When full-grown it reaches an inch and a half in length. On warm days they may often be found in batches, several lying parallel with one another, either on the outside of the tent or along the branches. They are somewhat timid, and fall to the ground on the tree being shaken, but soon crawl back to the foliage again. From the middle of June to the end of July they reach maturity, and spin a delicate loose white cocoon, the silk mixed with a yellowish powder and numerous hairs of the larvæ. These cases are formed amongst the leaves, on the bark, amongst grass below the trees, on walls, fences, &c.; always above ground. In this cocoon the larva changes to a dark-brown pupa, from which the moth hatches out in from two to three weeks.

The "Lackey" larvæ feed also on oak, elm, hawthorn, and many other trees and shrubs.

THE LACKEY MOTH.

(A) Tent and caterpillars. (B) Male moth. (C) Egg-ring (natural size). (D) Pupa (natural size).

II.—The Brown-Tail Moth.

According to Stainton the Brown-Tail Moth is local, and not to be found everywhere. Where it does occur, however, it is often very abundant. It is recorded from Lytham, Epping, Teignmouth, Lewes, Lymington, Tenterden, Ramsgate, Stowmarket, Black Park, Chesham, Deal, Dorking, Newhaven, Bisterne, Bristol, Norwich, Canterbury, and many other places. It is always more or less abundant in various parts of Kent. The moth appears towards the end of July and in August. The female has pure white fore wings, with a faint black spot; hind wings pure white. The male has similar fore and hind wings, white head, thorax and abdomen, the apex of the latter having a golden brown tuft. In length the wing expanse varies between an inch and a quarter and an inch and three quarters. It is a night flyer, resting during the day on walls, leaves, lamps, &c., and is then very sluggish, falling down as if dead when its resting place is shaken.

The female lays her eggs on the under surface of the leaves of the oak, elm, black- and white-thorn, apple, plum, and sometimes pear. Each patch of eggs is covered over by hair from the female's tail and completely hidden; the eggs are round, of a golden hue, and as many as two hundred and fifty may be counted in each batch.

The larvæ hatch out about the beginning of August, and live through the winter. At first they are very small, of a dirty yellow appearance, with a black head and four rows of black dots and numerous hairs. They at once spin a single leaf together, eating only the epidermis, and attaching the leaf by silk to the twig so that it cannot fall off.

Towards September they commence to make a regular tent or nest, attaching a number of leaves together by silk. The leaves are lined and covered with silk, and all firmly united. This nest is used as a place of protection from cold and damp, and as a nocturnal shelter. During the latter part of August the larvæ moult and still feed on as long as the leaves contain any sap. Even after the leaves have fallen it is not unusual to see the larvæ on a sunny warm day basking in the sun outside the tent. As the weather becomes cold, they become dormant and remain in their dwelling. In the spring they commence to feed on the leaves as they open, the larvæ wandering freely over the trees. Very frequently the colony divides, two nests being made, and sometimes even a third is formed. Early in May they moult again and assume a deep brown appearance with reddish-brown hairs, a row of white spots

D

B

A

C

THE BROWN TAIL MOTH

(A) Male moth. (B) Female moth. (C) Summer tent and larvæ.
(D) Winter tent of larvæ.

on each side, a narrow double broken line of red alone on the dorsum, black between, and with two prominent bright red tubercles on the back of the eleventh and twelfth segments, depressed in the centre ; these tubercles can be elevated or depressed by the larvæ at will. After this moult they spread out over the fruit trees, forsaking their nests, and then devour the leafage very ravenously.

From the end of June to the beginning of July they spin a cocoon amongst the leaves of fruit trees, as a rule several together forming a large mass united by a dusky web. In this they change to deep brown pupæ. As many as forty have been counted on a damson tree. From these pupæ the moths hatch out in the latter part of July and August, and soon commence to lay fresh eggs on the trees.

Natural Enemies.—Both the eggs and the larvæ of the Brown Tail Moth are attacked by Ichneumons.

These larvæ being hairy are avoided by birds, so that little help is given by them in the orchard when these pests are causing harm. The cuckoo is the only bird known to devour these hairy caterpillars. Two beetles destroy the larvæ of the Lackey Moth on the Continent, namely, *Calosoma sycophanta* and *C. inquisitor*.

Prevention and Treatment.

After an attack of Lackey Moths the orchards should be gone over in the winter and all egg-bands collected and burnt. Of course on large trees this is not possible, but where it can be done, it is a rule that should always be followed.

The small tents of the Brown Tail should also be looked for during the winter and cut off and burnt. Any tents left should also be collected and destroyed in the early summer either on a dull wet day or of an evening, that is when the caterpillars are at home, or no good would be done. As the larvæ readily fall when shaken, care should be taken to hold boards or a sheet beneath the pest when it is being cut off, otherwise little good will accrue, as the Lackeys soon get back to the trees.

A great deal of damage will be saved by spraying as soon as the attack is noticed, especially when the tents cannot be reached by hand. For this arsenical washes should be used. Of these washes the three best known are Paris Green, London Purple, and Arsenate of Lead. The latter is the best wash of the three, killing the larvæ and yet not damaging the leafage, as sometimes happens with Paris Green.

Paris Green Wash is prepared as follows :—Add ½ lb. Paris green to 100 gallons of water and thoroughly mix up 1 lb. of lime with the same. This must be kept well stirred. Paris green can be used where poultry and stock are kept, the

quantity applied to the trees being so small that it will have no effect upon animals.

London Purple is used as the above, the lime being again essential.

Arsenate of Lead is prepared as follows :—Dissolve 1 oz. of arsenate of soda in warm water, and add to 16 gallons of soft water. Then dissolve 3 oz. of acetate of lead in water and pour into the 16 gallons of liquid. Add to this 2 lbs. of treacle. In place of treacle the arsenate of lead wash may be mixed with paraffin emulsion and so a double insecticide prepared.

In all cases proper sprayers must be used with fine nozzles, so that a dense mist of the wash is thrown on the trees.

4, Whitehall Place, London, S.W.
July, 1901.
Revised, January, 1903.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Winter Washing of Fruit Trees.

A neglected orchard not only harbours all manner of insect enemies during the winter, which come out in the spring and commence their ravages in that particular orchard, but it forms a nursery or breeding ground from which other orchards are supplied with noxious insects.

It is desirable, therefore, that all such orchards should be treated in some way to stop the damage that is caused by the various insect pests they encourage.

For this purpose a caustic or burning wash known as Caustic Alkali Wash is most successful. This mixture serves a double function. It removes, by means of its caustic properties, all vegetal incumbrances, more particularly moss and lichens; and at the same time it causes all rough and decaying bark to fall off. A tree so treated soon assumes a more healthy appearance. By the removal of the moss and lichen from the trees, the favourite quarters of many hibernating insects are destroyed. The Woolly Aphis, the Apple Blossom Weevil, the Earwig, the caterpillar of the Codling Moth, Thrips, and numerous other small insects are found during the winter beneath the vegetal growths and rough bark on fruit trees. The destruction of their winter quarters places these troublesome pests at a disadvantage, and their number is in consequence materially reduced.

Scale insects, of which two at least are more or less harmful to fruit trees in this country, namely, the Apple Bark Louse or Mussel Scale and the Brown Currant Scale, may also be destroyed by caustic alkali wash.

Not only are moss and lichens, and the insects referred to above, destroyed or stopped from excessive increase by this wash, but it acts also in another way by attacking the eggs of certain species. The extent of its action on the eggs has not, however, been fully determined. Groups of the eggs of the Apple Sucker (*Psylla mali*) treated with it were all killed, as also were those of the Red Spider—a species of *Bryobia*—on fruit trees, and those of certain aphides. Spraying the wash over eggs recently laid had little effect on them, but, when the embryos were nearly matured, the majority of those of the insects mentioned above were destroyed.

At present, therefore, the wash is mainly recommended for cleaning the trees in an orchard and thus destroying the shelter of various insects during the winter, and for killing certain hibernating pests themselves, as the Codling cater-

pillar, Woolly Aphis, and others. It certainly has no effect in the open on the eggs of the Winter Moth and Lackey Moth, and on those of certain plant lice.

Caustic alkali wash has a most beneficial effect on both old and young orchards in which the trees are infested with moss and lichens, or with Woolly Aphis. The best time to spray the trees is about the middle of February, as the eggs of some insects and mites are then more likely to be affected than earlier in the winter, and it is not so late in the season as to harm any developing buds.

To prepare caustic alkali wash, first dissolve 1 lb. of commercial caustic soda* in water, then 1 lb. of crude potash (or "potashes" or pearl ash) in water. When both have been dissolved mix the two well together, then add ¾ lb. of soft soap or agricultural treacle, stir well and add sufficient water to make up to ten gallons.

As the wash has a burning effect on the hands, care must be taken in employing it. Rubber gloves are sometimes used to protect the hands, but these, unless close fitting, allow the wash to run under the rubber, and more harm is done than usual. With ordinary care the sprayers need suffer little inconvenience.

4, Whitehall Place, London, S W.,
November, 1901.

Revised, October, 1904.

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*The amount of pure caustic soda in commercial caustic soda varies from 50 to 98 per cent. The actual percentage for use in this wash does not matter at all, as the 98 per cent. is not injurious to the trees, and 50 per cent. will clean off moss and lichens. The wash has frequently been used at double the strength given in this leaflet, but this is, however, unnecessary.

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BOARD OF AGRICULTURE AND FISHERIES.

The Colorado Beetle.

Doryphora (*Leptinotarsa*) *decemlineata*, Say.

This potato pest is a beetle belonging to the genus *Doryphora*, now also known as *Leptinotarsa*. This genus seems to be tropical, Central America being its apparent home, although some species, including the Colorado Beetle or Spearman, occur in North America.

The adult female beetle is a little under half an inch in length, the male being slightly smaller than the female. In colour, the beetle is yellow, with five longitudinal dark lines on each wing case ; the legs are reddish with dark knee spots and feet ; the yellow mesothorax has also a few dark spots and a more or less irregular V-shaped mark in the middle ; the wings have a peculiar rosy hue, which is particularly noticeable when the beetle is flying in the sun. The adult hibernates during the winter months under any rubbish it can find, but especially buried beneath the surface of the ground. Its general depth in the soil during the winter seems to vary from a few to twenty-four inches. Riley says it has been exhumed from a few inches to several feet, though its habit is not to burrow deeper than ten inches.

The beetles come from their winter quarters when the weather becomes warm in spring. They are capable of flying some considerable distance, especially taking wing readily in the early part of the year. The warmer the day the more willingly do the insects fly.

The eggs are elongated oval in form, of an orange colour, and are deposited in clusters of from nine to forty. They seem to be nearly always placed on the under side of the leaf, and are attached to it by one end. They resemble the ova of some of the *Coccinellidæ* or Lady-birds, but are much larger than those of any of our native species. Riley says they hatch out in less than a week ; those under observation

were kept ten days before the larvæ came out. The females commence to deposit their eggs when the plants are quite young. The young larvæ are of a dull reddish-brown colour, and bear some resemblance to the larvæ of Lady-birds. As they grow they become paler in colour, varying from dull brickdust red to almost orange in hue, with the head, legs, and posterior part of the first segment black, and with two lateral rows of black tubercle-like spots, the upper row being the largest and composed of seven spots. As the larvæ become mature, the body is somewhat swollen and more or less arched, the apex terminating in a kind of sucker, the upper part of the two apical segments being black. When full grown the larva is rather more than half an inch long when extended.

The leafage is devoured very ravenously at times by the larvæ, which attach themselves to both upper and under sides and the edges of the leaves. They are also said to feed on the stalk, so that the whole potato haulm is attacked.

When mature, the larvæ fall to the ground and burrow under the soil and there pupate. In America this stage seems to last a week, for Riley, after stating that the larvæ mature in from two to three weeks, says, "the beetle stage is assumed in about a month from the time of hatching."

How many broods might appear in Great Britain is not known. As many as three are observed in North America, and there is no reason why three broods should not also occur in this country, as the larvæ seem to grow very rapidly.

When the weather commences to become cold in the autumn the beetles bury themselves in the earth, where they shelter during the winter, as well as amongst rough herbage and under rubbish of all kinds.

The beetles are extremely hardy and can withstand a large amount of rough usage. Both larva and adult can eject a dark fluid, which is thought by some to be poisonous, but which seems quite innocuous.

Its Food Plants.

There is no doubt that when pressed for food this beetle will take to a great number of plants besides the potato. In its native home it mainly feeds, under natural conditions, on two wild species of *Solanum*, *S. rostratum* and *S. cornutum*. The *Solanaceæ*, or nightshade and potato family, form its staple diet, especially the genus *Solanum*. The other species upon which the larvæ have been found in America, are the following: The common horse-nettle (*S. Carolinense*), found

in Missouri and east of the Mississippi; *S. robustum*, *S. discolor*, *S. Sieglingii*, and *S. Warscewiczii*.

The closely related tomato (*Lycopersicum*), the thorn apple (*Datura*), the henbane (*Hyoscyamus*), the tobacco plant (*Nicotina*), the apple of Peru (*Nicandra*), the ground cherry (*Physalis*), belladonna, and petunia have also been recorded as nourishing this pest, but upon scarcely any can it flourish except the tomato.

Various poppies, especially the Mexican or prickly poppy (*Argemone Mexicana*), also serve as food plants in America.

(A) Eggs. (B) Mature Beetles, the male to the left, the female to the right. (C) Larvæ. (D) Larva of Ladybird. (E) Mature Ladybird.

From the States it has also been recorded feeding on the following: The pigweed (*Amaranthus retroflexus*), the hedge mustard (*Sisymbrium officinale*), oats, smart-weed (*Polygonum hydropiper*), the red currant, various thistles, goosefoot (*Chenopodium hybridum*), thorough-wort (*Eupatorium perfoliatum*), the European black henbane (*Hyoscyamus niger*), and the mullein (*Verbascum*).

Grasses and other weeds have been known to harbour the larvæ. In some allotments at Tilbury Docks, where in 1901 an isolated colony of these beetles was found and destroyed, the larvæ were observed feeding on woody night-shade, cabbage, and thistles, whilst the eggs were found in one case on the sowthistle (*Sonchus*). It thus seems that although members of the genus *Solanum* are its chief diet, especially the cultivated potato (where its original food plants do not occur), both larvæ and adults can feed on a variety of other plants, preferably devouring the young leaves.

Its Natural Enemies.

A great number of natural enemies tend to check the beetle in America. Amongst these are birds which feed upon both larvæ and adults, especially the Rose-breasted Grosbeak (*Guiraca ludoviciana*).

Both ducks and chickens, but especially the former, devour the larvæ.

The toad in America (*Bufo Americana*) gorges itself with the grubs, and probably our British species would do the same.

Very numerous are the insect enemies recorded by Riley, especially amongst the Beetles or Coleoptera, and the Bugs, or Hemiptera-heteroptera. Strange to say, no members of the Hymenoptera, the order that contains so many parasites, are actually parasitic on *Doryphora*; a single species of Wasp (*Polistes rubiginosus*), however, occasionally provisions its nest with the larvæ.

Whilst examining the allotments at Tilbury, the large Seven-spotted Ladybird (*Coccinella septem-punctata*) was noticed in considerable numbers both in adult and larval stages. The larvæ were seen in one instance devouring the eggs of the Colorado Beetle, and when placed in a box with some ate them ravenously. Thus in the short space of time in which this potato pest existed in this country it found one natural enemy which, on account of its ravenous nature, could not but help materially in checking its increase.

The pupa of the Ladybird is orange with black marks and spots, and resembles very closely the small grub of the Colorado Beetle. A small Hemipteron, a green *Nemocoris* (?) was also seen wandering about amongst the larvæ, and may have been feeding off them, sucking out the body juices in the same way several species do in America.

If this beetle is found it is important to remember that, under the terms of the "Colorado Beetle Order, 1877," notice must be at once given to a constable. The constable is then required to communicate immediately with the Local Authority, who shall forthwith give notice by telegraph to the Board of Agriculture.

4, Whitehall Place, London, S.W.
March, 1902.

This leaflet is no longer issued.

BOARD OF AGRICULTURE AND FISHERIES.

The Purchase of Artificial Manures.

Artificial or, as they are sometimes called, chemical, or light manures are now so generally employed by farmers that a few suggestions may be offered in regard to their use and economical purchase.

There are three substances, and only three, that are valued in artificial manures, namely, nitrogen, phosphates and potash. According, therefore, to the greater or less quantity of one or other of these substances the value of the manure will rise or fall. Some manures contain only one of these substances—for instance, nitrate of soda and sulphate of ammonia contain only nitrogen; superphosphate, precipitated phosphate, and basic slag contain only phosphate; and kainit, sulphate of potash, and muriate of potash contain only potash—while other manures hold two substances that are valued, as in the case of bones, which furnish both nitrogen and phosphates, or saltpetre (very seldom used, however, as a manure), which supplies both nitrogen and potash. Only one class of so-called artificial manure, namely, Peruvian or other similar guano, contains an important amount of all three substances.

In price lists, **nitrogen** is often expressed as ammonia. The relationship between the two substances is, however, a very simple one, and need occasion no difficulty or uncertainty. 17 lbs. of ammonia always contain exactly 14 lbs. of nitrogen, or, what is the same thing from the farmer's point of view, 14 lbs. of nitrogen are the equivalent of 17 lbs. of ammonia. If, therefore, a sample of, say "Corn Manure," is offered as containing 4·5 per cent. of ammonia, this is the same as saying that it contains 3·7 per cent. of nitrogen. Sometimes, though not often, the figure is made to look more attractive by being stated as sulphate of ammonia, but this also need cause no difficulty, if it be remembered that 66 lbs. of this substance are equivalent to no more than 14 lbs. of nitrogen or 17 lbs. of ammonia. If, therefore, we take the above example, the figures mean one and the same thing, whether they are stated as 3·7 per cent. of nitrogen, or 4·5 per cent. of ammonia, or 17·4 per cent. of sulphate of ammonia. But a manure merchant, who failed to effect many sales for a fertilizer, of ever so high-sounding a name, on a statement of 1 per cent. of nitrogen or 1·2 per cent. of ammonia, might be more successful with a certain

class of buyer if he entered the nitrogen as equal to 4·7 per cent. of sulphate of ammonia, and yet the three figures all represent the same fact. Under the Fertilizers and Feeding Stuffs Act, 1893, the invoice must contain the minimum guarantee of nitrogen, stated as such.

Phosphates or **phosphate of lime** may also be entered in an analysis or price list in several ways, but as a rule this ingredient is either stated as above, or as phosphoric acid. In an invoice, however, the statement must be made as soluble or insoluble phosphates, as the case may be.

The relationship between phosphates or phosphate of lime, whether soluble or insoluble, and phosphoric acid, is quite as simple as that between nitrogen and ammonia. 142 lbs. of phosphoric acid always form 310 lbs. of phosphate of lime; so that to convert the former into the latter one may multiply by 2·2, which, though giving an answer slightly above the truth, is quite accurate enough for all ordinary purposes.

If therefore the analysis of a manure is returned as 12 per cent. of phosphoric acid, it is equivalent to saying that it contains fully 26 per cent. of phosphates. Similarly 30 per cent. of phosphates is equal to nearly 14 per cent. of phosphoric acid.

Potash usually exists in manure in the two forms of sulphate of potash and muriate or chloride of potash. It takes 94·2 lbs. of pure potash to form 174·2 lbs. of sulphate of potash, whereas the same amount of potash will form only 149·2 lbs. of the muriate or chloride. In the former case, therefore, to convert potash into terms of sulphate of potash, we multiply by 1·85, whereas in the latter case we multiply by 1·58. If therefore an analysis of, say, kainit is stated as 12·5 per cent. of potash, this is equivalent to saying that it holds over 23 per cent. of sulphate of potash; while muriate of potash guaranteed to contain 56·8 per cent. of potash is of about 90 per cent. purity.

Just as a buyer may sometimes be led into purchasing a manure through its nitrogen being expressed as sulphate of ammonia, so may the contents of potash be made to look more attractive by being stated as sulphate of potash. In an invoice, however, the potash must be stated as such.

The rules for approximately converting the various terms into their equivalents may be thus summarised :—

To convert	nitrogen........	into terms of	ammonia...........	multiply by	1·2
" "	nitrogen........	" " "	sulphate of ammonia	" "	4·7
" "	phosphoric acid	" " "	phosphates..........	" "	2·2
" "	potash..........	" " "	sulphate of potash..	" "	1·85
" "	potash..........	" " "	muriate of potash..	" "	1·58

Nitrogen and phosphates, and, to a less extent, potash, vary in effectiveness, and therefore in value, according to their source or origin. Nitrogen is never so effective as when in the form of nitrate of soda. It is not quite so active, and for some purposes not so valuable, when in the

form of sulphate of ammonia, though under certain circumstances this somewhat slower action may be regarded as an advantage. Nitrogen in, what is called, the organic form is in its least active condition, though here again the rapidity and effectiveness of action vary greatly. Nitrogen is in the organic form in blood meal, fish meal, bones, shoddy &c., and yet as a source of plant food blood meal is more active than these other substances. It is claimed as an advantage for slow-acting manures that they last longer, which is true ; but one applies manures not to last but to act. It is only where it is convenient to apply manure at somewhat long intervals, as in the treatment of orchards, that the more inert manures are worthy of much consideration.

As regards phosphatic manures, it may be said that while soluble phosphates are all alike active, there is considerable difference in the value of insoluble phosphates. The insoluble phosphate of bone meal, for instance, is less effective, and for most purposes less valuable, than the insoluble phosphate of basic slag, or precipitated phosphate. But raw bones as a manure have been longer known to British farmers than other forms of phosphate, and apparently for this reason their price has kept relatively high.

The More Important Manures.

The purely nitrogenous manures.—The most important are nitrate of soda and sulphate of ammonia, others in less general use being rape dust, blood meal, shoddy &c. Other things being equal, nitrate of soda is specially suitable :—

(a) For use in spring and early summer, as in the manuring of hay, cereals, potatoes and mangolds.
(b) For use on heavy land.
(c) For use as a top dressing.
(d) For use in a dry district.
(e) For use where immediate effect is desired.

Speaking generally, sulphate of ammonia suits better :—

(a) For use on crops that make their growth late in the season, for example, turnips.
(b) For use on light land.
(c) For use on soil holding abundance of lime.
(d) For use where it can be mixed with the soil (in contrast to top-dressing).
(e) For use in a wet district.

It is, however, often difficult to say for which of these two manures the conditions are most suitable ; and then the question should be decided either by the relative cost of the substances, or by using a certain amount of both.

If one of the organic manures can be bought at a cheap rate it may be used to some extent as an ingredient of a mixture.

Nitrogenous manures cannot usually be profitably employed on leguminous crops (peas, beans, clover, &c.); and on a mixed crop of, say, clover and grass, if the clover is to be preserved against suppression, they must be used sparingly, if at all. They must also be used with caution on barley, and especially so where a fine sample, rather than large yield, is looked for. Other crops, however, generally respond satisfactorily to the use of this class of manure.

Nitrate of soda and sulphate of ammonia are apt to be lumpy, therefore the farmer should look carefully to the mechanical condition. Nothing should be applied that will not pass a ½-inch riddle. Lumps larger than this will often kill plants with which they may come into contact.

Nitrate of soda is generally offered on the basis of 95 per cent. of purity (= 15·6 per cent. nitrogen or 19 per cent. ammonia), while commercial sulphate of ammonia usually contains 97 per cent. of the pure article (= 20·6 per cent. nitrogen or 25 per cent. ammonia). Sulphate of ammonia is thus the more highly concentrated manure.

The purely phosphatic manures.—Of these superphosphate and basic slag are the most important. The former is, speaking generally, more suitable for use under the following circumstances :—

(a) Where rapid effect is wanted.
(b) In spring.
(c) For arable land.
(d) For admixture with sulphate of ammonia.

Basic slag is specially suitable :—

(a) For use in autumn.
(b) For use on grass land.
(c) For use on land holding much peat or other vegetable matter.
(d) For use on land addicted to finger and toe.
(e) For use in orchards.
(f) For admixture with nitrate of soda.

Basic slag generally leaves little to be desired as regards mechanical condition, provided the grinding be fine enough (80 per cent. through a No. 100 sieve—that is, 100 wires per linear inch, or 10,000 apertures per square inch—should be the minimum requirement). Superphosphate is sometimes almost as dry and mealy as slag, but in other cases it is lumpy and sticky. Samples of the latter character are of reduced value, and should be avoided.

Superphosphate contains from 25 to 38 per cent. of soluble phosphate, from 28 to 30 per cent. being a very usual quantity. Basic slag also varies in quality, the usual contents being 35–40 per cent. of insoluble phosphate, though there may be as little as 22 per cent., or as much as 45 per cent.

Phosphatic manures are of special value in the manuring of turnips, leguminous crops, hay, and pasture. They are of less importance for potatoes and mangolds, and least of all for cereals. In the case of the last class of crops it usually happens that the plants are able to satisfy their requirements, as regards phosphates, from the natural supplies in the soil, or from residues of former applications. Whether, on any particular farm, it will pay to apply a direct phosphatic dressing to a corn crop can only be determined with certainty by means of a simple field experiment.

The nitrogenous-phosphatic manures.—The most important of these is dissolved bones, though bone meal, fish meal, &c. have their value for certain purposes.

Dissolved bones lose in value through being damp and lumpy; they can, however, be bought as dry and almost as fine as superphosphate. They usually contain 32–34 per cent. of total phosphates (of which more than half should be soluble) and fully 3 per cent. of nitrogen.

Bone meal should be very fine and free from grease. Any particles $\frac{1}{10}$ of an inch or upwards in size become available very slowly. It should hold about 50 per cent. of phosphates, and 4 per cent. of nitrogen.

Potash manures.—Genuine kainit contains about $12\frac{1}{2}$ per cent. potash, besides which it holds over 30 per cent. of common salt. Where, therefore, a farmer wants to use the latter substance he may find it to his advantage to employ this manure.

Sulphate of potash is offered in various degrees of strength, containing from 25 to over 40 per cent. of potash. Muriate or chloride of potash often holds over 50 per cent. of potash.

All potash manures are apt to be lumpy, and if they are stored long they may become so hard as to be almost unmanageable. Poor mechanical condition is here quite as undesirable as in the case of other manures.

Potash manures are most important for root and leguminous crops, less so for grass and cereals. There are many well-authenticated instances of potash manures doing positive harm to meadows, though in other cases they have been used effectively. Whether they are wanted on any particular farm or not can only be determined by experiment.

Valuation of Artificial Manures.

There are various methods of valuing artificial manures, of which that known as valuation by units is most employed by farmers and dealers. The general trend of prices is determined by market influences, and is largely beyond the farmer's control, but a reliable method of valuation enables him quickly and accurately to conclude which of several samples of the same class of manure is the cheapest. The

following figures are given by way of illustration only, inasmuch as prices fluctuate considerably from year to year, and in different parts of the country, owing to a variety of causes.

For the purposes of the valuation of artificial manures a unit may be taken as synonymous with one per cent. of the valuable substance in a manure. To find the value of a unit we divide the price of a ton by the percentage composition of the manure. Thus, for example, if **sulphate of ammonia** contains 20 per cent. nitrogen, and costs say £11 per ton, the nitrogen works out at £$\frac{11}{20}$ = 11s. per unit. Or as 20 per cent. of nitrogen is equivalent to about $24\frac{1}{4}$ per cent. of ammonia the cost of a unit of ammonia is 9s. 1d. We can use one or other of these unit-values to enable us to determine which of several samples of sulphate of ammonia is the cheapest. Suppose that we are offered other two samples, the one guaranteed $18\frac{1}{2}$ per cent. and the other 16 per cent. of nitrogen, the price per ton of the former, on the same basis, should be $18\frac{1}{2} \times$ 11s. = £10. 3s. 6d. while that of the latter should be $16 \times$ 11s. = £8. 16s. Comparing these figures with the price actually demanded we are able at once to determine which of the three lots of manure is the cheapest.

It may be mentioned that it would be rather exceptional to have the opportunity of obtaining sulphate of ammonia so poor in nitrogen as 16–18 per cent., but dirty samples do sometimes occur, and if the quotation of a price, to include carriage, can be obtained, one can sometimes secure good value in a low-class manure, provided the impurities are of a perfectly harmless character.

The value of a unit of nitrogen in nitrate of soda is generally rather higher than it is in sulphate of ammonia, which means that farmers regard nitrogen from the former source as rather the more valuable.

When sulphate of ammonia is selling at about £11 per ton **nitrate of soda** will usually be costing about £9. On a basis of $15\frac{1}{2}$ per cent. of nitrogen, the value of a unit in the latter case works out at $\frac{£9}{15 \cdot 5}$ = 11s. 9d., that is 9d. higher than in the case of sulphate of ammonia. If we use this unit to value sulphate of ammonia, we should get the value of a ton as $20 \times$ 11s. 9d. = £11 15s., which is 15s. higher than this manure can usually be bought for when nitrate of soda is at £9 per ton. Now, it lies in the power of many farmers to secure this 15s. by depending on sulphate of ammonia rather than nitrate of soda where the conditions are specially suitable for the use of the former substance. When sulphate of ammonia costs more, per unit of nitrogen, than nitrate of soda, as occasionally happens, the latter manure is almost invariably to be preferred.

As a rule, organic nitrogenous manures are priced on the market at a much higher rate per unit than is the case with

the two manures just looked at. The results of their use do not justify this position, for organic nitrogen will not produce so much increase as nitrogen from nitrate of soda or sulphate of ammonia. If we employ 11s. 9d. as the value of a unit of nitrogen in its most effective form, and apply it to the valuation of some organic manures, we should get some such results as these :—

Fish meal, say 8 per cent. nitrogen × 11s. 9d. = £4 14s., together with an allowance of about £1 for phosphates, giving a total value of £5 14s. per ton. Some samples of fish meal hold more and some less than 8 per cent. of nitrogen, in which case the value would rise or fall, though not quite proportionately, on account of the phosphates.

Blood meal, say 12 per cent. nitrogen × 11s. 9d.=£7 1s., together with about 5s. on account of a little phosphate.

Rape meal, say 5 per cent. nitrogen × 11s. 9d.=£2 18s. 9d. per ton.

The values per ton for these three manures are usually higher than their merits would appear to warrant. These manures, in fact, are only worthy of a farmer's attention, under ordinary circumstances, when they can be bought at a rate per unit of nitrogen that is considerably less than that which applies to nitrate of soda or sulphate of ammonia.

Phosphatic manures are also valued in the same way. If at any time the insoluble phosphates in **basic slag** are valued at 1s. 3d. per unit, a sample containing 40 per cent. would cost 40 × 1s. 3d. = £2 10s. per ton, while a 30 per cent. sample would be no better value at 37s. 6d. As a rule, the lower grades cost more per unit than the higher qualities, so that the latter are usually the better value.

Valuing the soluble phosphate of **superphosphate** at 1s. 9d. per unit, a 28 per cent. sample would cost £2 9s. per ton, while a 34 per cent. sample would be as good value at £2 19s. 6d. If 2s. were the rate per unit the cost per ton would be £2 16s. and £3 8s., respectively.

In **bone meal**—which should only be bought when very finely ground, really dust—the nitrogen is usually valued at about the same rate as that in sulphate of ammonia, while the phosphate may be put at the same rate as that which prevails for basic slag. On this basis, a sample containing 4 per cent. nitrogen, and 50 per cent. insoluble phosphates, would, at the rates assumed above, work out as follows :—

		s.	d.		£	s.	d.	
4	×	11	0	=	2	4	0	
50	×	1	3	=	3	2	6	
		Total			£5	6	6	per ton.

in **dissolved bones** the market rate for nitrogen may be put at that which prevails for nitrate of soda, while the rate for the insoluble phosphate is usually the same as that in bone meal. The soluble phosphate in this manure is exactly the same substance, chemically, as that in superphosphate, and yet it is generally valued about 1s. per unit higher. The only justification for this would appear to lie in the fact that the insoluble phosphate, being partly reverted, should be valued somewhat higher than that in raw bone, and raising the rate for the soluble phosphate makes some allowance for this.

Taking these figures, and assuming a good sample of dissolved bones, we come to the following result:—

		s. d.		£ s. d.	
3 % nitrogen	×	11 9	=	1 15 3	
20 % soluble phosphates	×	2 9	=	2 15 0	
14 % insol. phosphates	×	1 3	=	0 17 6	
		Total		£5 7 9	per ton.

Although this is often about the market rate for dissolved bones, it would appear to be higher than their intrinsic merit warrants.

Kainit can usually be bought at the rate of 4s. per unit of potash, so that on an analysis of 12¼ per cent. of potash the price of a ton would be 12¼ × 4s. = £2 9s.

Sulphate of potash, containing 25 per cent. of potash (corresponding to a purity of about 46 per cent.), would at the same rate be worth 25 × 4s. = £5 ; while high-class manure, containing, say, 40 per cent. of potash (corresponding to a purity of about 74 per cent.) would be worth 40 × 4s. = £8.

In point of fact it is generally found that in the higher grades of sulphate of potash the unit-value of potash is somewhat higher than that in kainit, so that, with kainit at £2 9s. per ton, the market value of sulphate of potash of a purity of 74 per cent. is likely to be about 40 × 4s. 3d. = £8 10s.

With a light haulage, and especially if the manure can be applied in autumn or early spring, so as to admit of certain undesirable magnesia salts being washed out, kainit is usually the preferable manure ; but, for use at seed-time, and especially when mixed with other manures, sulphate of potash has advantages.

Muriate of potash is usually placed on the market of a purity of 80–90 per cent., corresponding to 50–57 per cent. of potash. Taking the former quality, and adopting the unit-value assumed for potash in kainit, the price of a ton would work out at 50 × 4s. = £10. Generally a unit of potash in muriate is valued at a lower rate than that in kainit or

sulphate of potash, so that at the rates assumed the market quotation per ton is likely to be about $50 \times$ 3s. 9d. = £9 7s. 6d.

Muriate of potash, in fact, usually offers the cheapest supply of potash, and for most crops it is probably as effective as any potash manure, while for potatoes it would seem to be superior

The most important example of a manure holding nitrogen-phosphates and potash is **Peruvian and similar guano.** The composition varies within wide limits, but the following may be taken as an example :—

			s.	d.		£	s.	d.
Nitrogen	12%	×	11	9	=	7	1	0
Sol. phosphates	5%	×	1	9	=	0	8	9
Insol. phosphates	15%	×	1	3	=	0	18	9
Potash	2%	×	4	0	=	0	8	0
			Total			£8	16	6

If the soluble phosphates be valued at the rate assumed for Dissolved Bones the price will work out at £9 1s. 6d.

Such a manure, however, would probably be priced at a much higher rate, so that guano, like bones, would appear to be still under the influence of past traditions.

It may be pointed out that the purchase of manures at a certain rate per unit, subject to analysis by an approved chemist, makes a farmer largely independent of variations in quality. If, for instance, he agrees to pay 1s. 3d. per unit, including carriage, for phosphates in basic slag, it is a matter of comparative indifference to him whether the consignment proves to be of 35 or 40 per cent. quality. In the former case the price per ton would be $35 \times$ 1s. 3d. = £2 3s. 9d., while in the latter case, it would be $40 \times$ 1s. 3d. = £2 10s., and the value would be as satisfactory in the one case as in the other. Needless to say, he would not apply the manure to his land till he was in possession of the analysis, and then he would regulate the dressing with some regard to the quality of the material.

4, Whitehall Place, London, S.W.,
April, 1902.
Revised, June, 1902.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Cultivation of Maize for Fodder.

This crop has been grown on a small scale in certain parts of England for several years, but the dry summers of the past decade, and the reports of the success of the crop in Canada and the United States, have recently been the means of securing for it from British farmers a largely increased amount of attention.

Maize, when grown for fodder, does not demand a better climate than many districts of England are able to offer, while as regards soil-requirements and expenses of cultivation it compares favourably with most of our fodder crops.

Situation, Soil, and Manure.

Taking an average of seasons it is doubtful if the cultivation of maize is likely to prove of advantage north of the English Midlands. In the Southern and South Eastern Counties, however, where a low rainfall, and frequently recurring periods of drought, make the growth of roots rather uncertain, maize offers the opportunity of securing a large bulk of succulent material that may to a considerable extent replace the common fodder crops.

While this crop may be grown on a variety of soils (sand, clay, and fen-land) it is found to give its best return on a mild deep loam. The land should be ploughed early so as to secure a good tilth, and in spring the ground should be cleaned, and generally prepared as for roots.

Ten or twelve tons of farmyard manure, supplemented, when the crop is above ground, by 1–2 cwt. of nitrate of soda, would be sufficient manuring. In the absence of farmyard manure artificials alone may be employed, the dressing per acre consisting of 1 cwt. sulphate of ammonia, 3 cwt. superphosphate, and, on light soil, 3 cwt. kaïnit, applied before sowing; supplemented a month later by 1–2 cwt. nitrate of soda.

Cultivation and Sowing.

The seed may be sown from the middle of May till the middle of June, though, in the case of May sowings, the

young plants run considerable risk of injury from frost. In America and on the Continent there are varieties of maize specially adapted for fodder purposes, and probably some of these are suitable to English conditions. But results which are considered sufficiently satisfactory are got in this country from the use of the ordinary flat white maize that is sold for feeding purposes, provided care be taken to ascertain by experiment that its germinative capacity is satisfactory, say 90 per cent. or upwards. It is of the utmost importance that such a test should be carried out, as owing to heating much commercial maize is incapable of germination.

The seed may be sown in a variety of ways, *e.g.* by hand-dibbling, by means of a bean drill &c., the best results being attained by placing the rows not closer than 16 inches, and by burying the seed to a depth of about $2\frac{1}{2}$ to 3 inches. A plan that is followed with success is to deposit the seed in the bottom of every second furrow, as is often done in the sowing of beans. It may be mentioned that in America it is the custom to make the distance between the rows greater than in this country, say $2\frac{1}{2}$ to 3 feet. The quantity of seed varies between $1\frac{1}{2}$ and $2\frac{1}{2}$ bushels per acre. Heavy rolling after sowing is recommended by several of the best growers.

The greatest trouble, in many cases, arises from the attack of rooks, which search for the sprouting grain with much persistency. It is therefore absolutely necessary that means be taken to keep these birds off, and this is best done by "stringing" the field before the sowers leave it. If this operation be delayed, and the rooks discover that maize is in the ground, it is extremely difficult subsequently to keep them off. Tarring the seed before sowing, as a method of prevention, is also practised with fair success.

When the young plants appear above ground horse and hand hoeing must be attended to, as in the case of other drilled crops; but when once fairly established maize, being a rank-growing plant—reaching, as it does, a height of 5 or 6 feet—will largely suppress weeds.

Utilization.

The crop may be utilized in several ways. It is found to be very useful for scattering on bare pastures in August and September, where it is readily eaten by all kinds of stock, not excluding pigs. In America, and to some extent in this country, the main value of the crop is due to the opportunity it provides, through the agency of ensilage, of securing a supply of nutritious succulent material for use in the winter and spring months.

The quality of the silage that maize produces is excelled

by that of no other crop. If maize be utilized in this way it should stand till it is as mature as it is likely to become in this country, though it must be got off the fields before the occurrence of autumn frosts. Generally speaking the latter half of September is the best time to make maize silage, which may be produced in stacks, draw-heaps, silos, pits, &c. (For general information in regard to ensilage, see Leaflet No. 9.) The practice of several farmers is to utilize as much of the crop as possible in a green condition, and, about the middle of September, to make what remains into silage. In order to admit of the completion of the fermentative changes it is desirable not to feed maize silage to stock till well into spring. At that time a good sample is of a greenish brown colour, and emits an aroma almost indistinguishable from that of strong tobacco. It is much relished by stock, and seems to have a feeding value equal, if not superior, to that of mangolds.

4, Whitehall Place, London, S.W.
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Leaflet No. 74.

BOARD OF AGRICULTURE AND FISHERIES.

The Purchase of Feeding Stuffs.

In making purchases of cakes and other feeding stuffs a farmer often experiences a difficulty in arriving at a conclusion as to what material to buy, or which particular brand of cake to select.

The circumstances that will determine his selection are very various, but a few of the considerations that deserve attention are here indicated. The present leaflet, however, is chiefly confined to considerations affecting the selection and purchase of foods, and does not touch—or touches only incidentally—other important matters, such as the compounding of rations which will be dealt with subsequently.

In order to buy feeding stuffs intelligently it is necessary that a farmer should be well acquainted with the contents of the commoner foods, and should be in a position to appreciate the value and uses of the various nutrient ingredients. Such knowledge is of service in enabling him to select the foods that are at any time in a favourable position on the market, and so to compound rations that are at once cheap and effective.

General Composition of Foods.

The accompanying arrangement illustrates the component parts of all foods, whether home-grown or purchased :—

Feeding Stuff	Water		
	Dry Matter	Nitrogenous substances	Albuminoids (Proteids)
			Amides
		Non-nitrogenous substances	Fats and Oils
			Carbohydrates
			Fibre
			Mineral matter (Ash)

Commencing from the left hand, it will be seen that feeding stuffs are primarily made up of water and dry matter, and that the latter consists of nitrogenous and non-nitrogenous constituents, which, again, may be sub-divided—the nitrogenous into albuminoids and amides, the non-nitrogenous into fats, carbohydrates, &c.

Albuminoids.—The albuminoids or proteids are the true flesh, lean meat or muscle formers, and are sometimes termed

the "essential" or "indispensable" food ingredients, because without them life could not be maintained. They contain nitrogen to the extent of about 16 per cent., which, together with part of the carbon, hydrogen, and oxygen, is utilised for the construction and repair of animal tissue; while the rest of their carbon and hydrogen, by combustion in the body, is utilised to maintain the heat of the animal and to supply energy or mechanical force. Beyond this, the albuminoids, if used in excessive quantity, may contribute to the production of fat, or, at least, may protect the fat stored up in the tissues from consumption. If albuminoids are fed in greater amount than is required to repair the waste of animal tissue, the excess is merely burnt up, and has no more value than an equal amount of carbohydrates, which are much cheaper. Many farmers commit a grave error in using rations excessively rich in albuminoids.

The foods chiefly distinguished for richness in albuminoids are linseed and cotton cakes; but beans, peas, dried grains, and malt dust also contain a large amount of these substances.

Amides.—The amides, although containing nitrogen, are of comparatively little value as flesh-formers. They appear to be heat-producers, and therefore serve the same purpose in the body as the carbohydrates. In heat-producing capacity, however, the amides, weight for weight, possess only about half the value of carbohydrates. Important amounts of amides occur neither in the seeds from which cakes are made nor in corn or other mature vegetable products, so that, in the present connection, they may be left out of consideration.

Carbohydrates.—The most important are starch, sugar, and mucilage, after which comes cellulose. Carbohydrates comprise the bulk of the feeding material in cereal grains, hay, straw, and roots, and in these foods they must be looked upon as the chief ingredients of value. In oil cakes, pulse grains, dried grains, and malt dust, the feeding value is derived to a large extent from albuminoids and fats. The chief function of the carbohydrates is to supply heat and energy, and when fed in large quantity they are also capable of producing animal fat.

Fat and Oil.—The fats and oils are extremely potent heat-producers, and, weight for weight, are nearly 2½ times as valuable for this purpose as the carbohydrates. It has, in fact, been found by experiment that a pound of pure fat can produce as much heat as about 2½ pounds of pure starch or sugar. When sufficient heat-forming food has been consumed to maintain the temperature of the body, fats and oils may be largely stored up by the animal consuming them, and so increase its weight. Linseed, linseed cake, and decorticated cotton cake are the foods richest in fat,

after which come dried grains, undecorticated cotton cake, oats, and maize.

Fibre.—Fibre consists mainly of cellulose, and though, under certain circumstances, it may be so affected in the animal's body as to have some feeding value, its importance in this respect is not great.

Mineral Matter.—Mineral matter, although performing an indispensable function in animal nutrition, may be neglected in arranging diets for mature animals, as it is usually present in sufficient quantity in all foods. This constituent of food is of more importance in arranging diets for young, growing animals.

Comparative Values of Foods.

Manures can be valued, conveniently and reliably, by taking the number of units of the manurial element or elements that they contain, and multiplying by the market value per unit of such elements. (See Leaflet No. 72.) Although this system of valuation cannot be employed with so much ease and certainty in the case of feeding stuffs, it is the only one that admits of the use of definite and detailed figures, and, if applied intelligently, it is capable of furnishing useful information.

In the case of manures three substances only are valued, namely, nitrogen, phosphates, and potash. Similarly, in the case of foods, the valuer has regard to but three constituents, which in this case are albuminoids, fat (or oil), and carbohydrates.

In comparing the three main constituents of food, albuminoids and fat (or oil) are generally credited with a value which is about $2\frac{1}{2}$ times as great as that of carbohydrates, so that, to get the number of units in a food, we multiply the percentage of albuminoids and oil by $2\frac{1}{2}$, and to the product add the percentage of carbohydrates. As a formula it may be thus expressed :—

$2\frac{1}{2}$ (albuminoids + oil) + carbohydrates = total food units.

Suppose that a sample of linseed cake guaranteed to contain 32 per cent. albuminoids, 11 per cent. oil, and 34 per cent. carbohydrates is offered at £9 per ton, the number of units is $2\frac{1}{2}(32 + 11) + 34 = 141\frac{1}{2}$, and the value of a unit is therefore $\frac{£9}{141\frac{1}{2}} = 1s.\ 3\frac{1}{4}d.$

Assuming that another sample of similar cake is offered whose composition is guaranteed at 28 per cent. albuminoids, 9 per cent. oil, and 35 per cent. carbohydrates, the number of units in this case is $2\frac{1}{2}(28 + 9) + 35 = 127\frac{1}{2}$, and this, at $1s.\ 3\frac{1}{4}d.$ per unit, comes to £8 2*s.* per ton.

The value of different brands of the same kind of cake, say

linseed, does not depend altogether on the chemical composition; other circumstances, such as hardness, freshness, &c., being not without material influence. And if there are difficulties in the way of depending entirely upon the system of units in determining the value of different samples of the same kind of feeding stuff, the difficulties are so great as to render the system practically inapplicable where different kinds of feeding stuffs are compared.

The Chief Feeding Stuffs.

Linseed.—The chief sources of the supply of linseed are India, Russia, and America. Russian seed is smaller in size and darker in colour than the Indian seed. Genuine well-cleaned linseed weighs not less than 52 lbs. per bushel.

The use of linseed—as distinguished from linseed cake—among farmers is chiefly restricted to the feeding of calves. It is found that linseed meal or crushed linseed added to skim or separated milk is one of the safest and most economical substitutes for the abstracted milk-fat. Linseed approaches more nearly in composition to the solids of milk than any other food, and the oil which it contains, to the extent of 34 to 38 per cent., is easily digestible. There is, however, a risk in buying any grain or seed in the form of a meal, as it is difficult to detect impurities when the material is sold in this condition. Farmers purchasing any considerable quantity of linseed meal will be well advised to have samples analysed occasionally. One of the commonest adulterants of linseed meal is ground linseed cake. The latter does not contain more than one-sixth to one-third of the oil in pure linseed, and the relatively larger amount of fibre in it renders it unsuitable for giving to young calves as a substitute for milk fat. Again, the meal of almost any cereal grain can be mixed with linseed meal in fairly large proportions before the substitution is likely to be detected with the naked eye. The object of such admixture is at once apparent, for linseed cake and cereal meals cost, roughly, about £6 to £12 per ton, whereas the price of genuine linseed is frequently about £20 per ton. The risk would be obviated by purchasing whole linseed and having it ground at home, but the objection to this is the difficulty of grinding owing to the linseed clogging the grist-mill.

Circumstances may arise in which it becomes desirable to use home-grown grain instead of purchasing linseed cake for the fattening of cattle or sheep. The following substances may be mixed in the proportions indicated and ground in an ordinary steel grist-mill.

8 bushels oats.
4 ,, barley (or maize).
2 ,, peas.
1 ,, linseed.

If this mixture be given to stock with an equal weight of ground decorticated cotton cake the whole will approximate in composition to good linseed cake.

Cakes.—There are many kinds of cattle cake, but four only are commonly used in this country:—Linseed cake, decorticated cotton cake, undecorticated cotton cake, and mixed or compound cakes.

Regarded as a group of feeding-stuffs, cakes may be considered as highly concentrated albuminoid or flesh-forming foods. For this reason, when consumed with a diet of straw and roots, which are essentially carbohydrate or heat-producing foods, they supply the feeding material that is most deficient. Where the straw is replaced by hay the concentrated food need not be so highly albuminoid in character, and, in that case, cereal grains may sometimes be economically substituted, partially or entirely, for cake.

Next to albuminoids the most important ingredient in cake is oil, and the price of certain sorts of cake is often largely controlled by the percentage of oil present. It is well known that oil is not equally valuable from whatever source it is derived, and it is important that all the oil in a cake should be the natural product of the seed from which the cake takes its name. This is a matter to which farmers, but especially chemists, should give their attention, as there is a strong temptation to increase the percentage of oil in cake by the addition of a cheap mineral oil that may have no feeding value. Thus in a linseed cake the whole of the oil present should be linseed oil. That the fattening capabilities of a cake are to some extent due to the oil there can be no doubt, as experiments upon sheep in this country have clearly shown the superiority of cakes rich in oil over others poor in this ingredient; but farmers should be careful that the extra percentage of oil in a cake is not purchased at too high a rate.

Linseed and cotton cakes contain no starch or sugar, the carbohydrates being represented by mucilage and cellulose. The amount of these present in such cakes is of minor importance compared with the albuminoids and oil, because the heat-forming (carbohydrate) substance is supplied in large measure by the straw and other bulky material with which cakes are always fed. Mixed or compound cakes often contain starch and also some sugar, their ingredients comprising grain, maize, &c., and a certain amount of spice.

Cakes, if pure and well made, are extremely digestible, as much as 80 to 90 per cent. of the nutrient material in them being often digested by cattle and sheep. The manurial residues of cakes made from oil seeds are of higher value than those of any other foods, although the residues of malt dust, dried grains, beans, and peas are not greatly inferior.

Linseed Cake.—This is the residue in the process of extracting

the oil from linseed or flax-seed. The quality and character of the cake varies with the following conditions :—(1) The kind of linseed used ; (2) The manner in which the seed has been screened and freed from its impurities ; (3) The amount of pressure that has been employed in the extraction of the oil and the compression of the residue into cake.

Of recent years the introduction of heating processes, and, more especially, the employment of chemical agents for the purpose of extracting the oil, have resulted in placing upon the market cakes which are very hard in consistency, close in texture, and poor in oil. It will usually be found in the case of linseed cakes that as the percentage of oil increases that of albuminoids diminishes.

In purchasing this cake, farmers should insist upon having the consignment invoiced to them as "Pure Linseed Cake," or simply as "Linseed Cake." They should not be content with such phraseology as "95 per cent. pure," "made from 95 per cent. linseed" or "made from seed pure as imported." When a cake is invoiced as "Linseed Cake," the vendor is bound under the Fertilisers and Feeding Stuffs Act to supply cake made from linseed alone and without admixture of other seed or substance. The term "Oil Cake" is very misleading, and may apply to a cake made from almost anything.

The chief kinds of linseed cake are English or Home-made Cakes, American, and Russian or Baltic.

Home-made cakes are usually fairly soft, and of late years they have been much freer from impurities than formerly, especially when sold under the designation of "Pure Linseed Cake." In regard to quality they usually contain 9 to 12 per cent. oil, and may be looked upon as intermediate in richness between American and Russian.

American cakes are usually rather hard and poor in oil but are correspondingly rich in albuminoids.

Russian cakes are darker in colour than American cakes. They are usually rich in oil, but are sometimes rather impure.

Although some other foods, or mixtures of foods, may produce as large an increase in fattening cattle, none has the samo capacity for imparting "finish" and "touch." The best feeders, therefore, generally finish their cattle on a liberal allowance of linseed cake.

Rough Tests of Linseed Cake.—Three methods are open to the farmer of gaining a rough idea as to the purity and quality of a linseed cake :—

(1) By inspection with the aid of a pocket magnifying glass and a penknife he can detect the presence of substances other than linseed when these are of fair size. As a rule, however, they are so much broken up as to be difficult of identification. The smooth, shining, dark, generally more

or less triangular-shaped seeds of Polygonum can often be seen. The round, dark-brown husks of rape seed are familiar. The seeds of corn cockle are dark brown and very rough on the surface. Corn spurrey is a black seed with an almost smooth surface and surrounded by a delicate disc. Pieces of straw can sometimes be detected, and sacking from the bags in which the cakes are pressed.

(2) The presence of too much sand may be suspected if the cake feels gritty when small pieces are crushed between the teeth. The flavour should be pleasing and not pungent or bitter.

(3) A jelly may be made by mixing one part by weight of the cake with six parts of boiling water. The jelly should have a mild taste and should not be bitter or rancid. If the jelly be covered up and warmed gently for some time the presence of mustard may be detected by the smell. Cakes resulting from the chemical process of oil extraction will not always form such a jelly. They are usually very poor in oil.

Cotton Cakes.—Raw cotton seed, as it is gathered from the plant, consists of three distinct layers of material. On the outside is a dense mass of long white fibres. The character of this layer gives to raw, uncleaned cotton-seed the appearance of small pellets of cotton wool. This outer covering of cotton is removed by the process of "ginning," and when this is thoroughly done the cleaned cotton seed shows the next layer, which consists of a smooth, dark-brown hull or husk. Inside this is the kernel, which, in Egyptian and American Sea Island seed, is whitish or yellow. In Indian and ordinary American seed the kernel is velvety. In the process of extracting the oil the kernels may first be removed from the hulls, or the hulls may be ground in along with the kernels. If the hulls are separated from the kernels we get decorticated cotton cake; if the hulls have not been removed we get undecorticated, rough, or "English" cotton cake. The latter cake is usually made from Egyptian seed, and the former from American seed.

Decorticated Cotton Cake.—This cake, when well made and in good mechanical condition, may be considered one of the cheapest and most valuable foods at the farmer's disposal. Weight for weight, it contains a larger aggregate amount of valuable material than any other food. Until recent years these cakes contained as a rule 14 to 16 per cent. of oil, but now the quantity of this ingredient has dropped to about 8 or 10 per cent. Some degree of compensation for the comparative poverty in oil is the increased percentage of albuminoids, which range from about 40 to 50 per cent., but deficiency in oil is often associated with a cake that is hard and "knotty."

The average composition of decorticated cotton cake at the present time is about 45 per cent. albuminoids, 9 or 10 per

cent. oil, and 20 per cent. carbohydrates. At ordinary rates this is one of the cheapest foods in the market, though it is not suitable for calves, lambs, or other young stock. unless given in small quantities, and in a finely ground condition.

It is most economically employed for dairy stock or fattening cattle, and as a rule should be accompanied by about an equal weight of some starchy food like maize or barley. When fed in this way experiments have shown that this food may be usefully employed both for fat stock and dairy cows. It is generally held to be superior to linseed cake where first-rate samples of butter are required; it renders the butter firm and easily manipulated, and imparts good keeping qualities, and a high melting point. The very high quality of the manure made from this cake is a point that experienced farmers do not overlook. This cake is largely used in certain parts of the country, notably in Scotland; whereas in others it is rarely seen.

The chief points to be observed in purchasing decorticated cotton cake are:—(1) To see that the cake is made wholly from decorticated seed; (2) to see that it is in suitable condition, and free from mould. With regard to the first point, the seed may not have been efficiently hulled, or the hulls may have been removed, ground up, and subsequently added to the meal, and the whole pressed into cake. Any appreciable quantity of coarse husks in the cake can be readily detected with the naked eye, but when the husks are present in a thoroughly disintegrated condition, their detection is only possible by chemical and microscopical examination. Cakes of this description exhibit a low percentage of oil (5 or 6 per cent., instead of about 10 per cent.), and a high percentage of fibre (18 to 20 per cent., instead of about 5 per cent.). Such cakes are practically little, if any, better than undecorticated cotton cake.

The hard button-like pieces sometimes found in decorticated cotton cake are extremely objectionable. To produce a softer cake some manufacturers have lately adopted the plan of grinding up the cake and re-pressing it into shape, while in other cases it is put on the market in a ground condition, and is often known as "yellow meal." As impurities are not so easy of detection in the meal as in the cake, it should be bought with greater caution. If the cake is only moderately hard, and can be passed conveniently through the breaker, it may be crushed and left exposed to the atmosphere for a few days, when it becomes softer and more suitable for stock. When exposed to the air in this way decorticated cotton cake becomes darker in colour, and it may also be noted that freshly-made cakes are much brighter than old cakes.

Undecorticated Cotton Cake.—The average composition of this cake may be put at about 23 or 24 per cent. of

albuminoids, 5 or 6 per cent. of oil, and 30 per cent. of carbohydrates. The amount of woody fibre present is an important point; this is usually about 20 per cent., and should not rise much above that figure.

The most common faults of this cake are (*a*) the presence of too much cotton fibre, due to imperfect ginning of the raw seed; (*b*) excessive amount and coarseness of husk. After the first ginning process there still remains attached to the husk a fine downy layer of cotton fibre, and this is extremely difficult to remove. Thus there is always a possibility that the seed will not be efficiently cleansed of such cotton, which can be easily detected by the woolly appearance of the cake when broken across. Coarseness of husk, and husk in excessive amount, are also serious objections, and have frequently been the cause of fatalities amongst stock.

The husk present in this cake possesses an astringent property which checks any tendency towards looseness in bowels, and for this reason the cake is useful when fed along with laxative food, such as fresh young grass in the spring, and the aftermath or foggage of hay fields. In many parts of the country undecorticated cotton cake is the feeding stuff most commonly used during the grazing season.

The comparatively low percentage of oil and albuminoids, and the high percentage of fibre, render undecorticated cotton cake much inferior to decorticated cotton cake as a feeding material. Many experiments have been conducted with the object of contrasting the two kinds of cotton cake as foods for fattening cattle. The evidence thus furnished is entirely in favour of the decorticated cake, which, irrespective of its superior manurial value, was found to be worth £2 to £3 per ton more than the rough cake.

Rape Cake.—This cake is not now much used as a feeding stuff in this country, the objection to it being the frequent presence of mustard seed, and the disagreeable flavour that it imparts to milk. It is, however, a highly nutritious food rich in albuminoids, and, if care be bestowed in its purchase, it can be advantageously given to stock, especially sheep, as the experience of several successful farmers testifies.

Compound or Mixed Cake.—The use of cake of this description is apparently on the increase, at least in certain districts. Frequently some material, like ground linseed or cotton cake, is taken as a basis, and the bulk is made up of ground cereal grains, such as maize, barley, &c. As a rule the mixture is flavoured and sweetened by the addition of spice, such as ground fenugreek or aniseed. Locust bean meal is also a favourite ingredient of these cakes, and of the mixed meals sold for lamb food and similar purposes. Locust beans are not often used alone, as their value is due rather to their giving a relish to other feeding stuffs, than to their actual nutritive contents. The sweet taste and pleasant aroma

which accompany compound feeding cakes, and the high degree of relish with which they are consumed by cattle, largely account for their popularity amongst farmers. Many experienced feeders use large quantities of such cakes with the best results, but they should be bought with even greater caution than is necessary in the case of pure cakes. They furnish an opportunity of getting rid of material (such as musty cake, warehouse sweepings, &c.) that cannot readily be sold in any other way, so that the buyer of compound cakes has a special inducement to deal with a firm of high reputation, and frequently to take the opinion of an experienced chemist.

Dried Grains and Malt Dust.—This food is obtained by removing the excessive moisture from wet grains or draff, to such an extent that only about 14 or 15 per cent. of moisture remains. Dried or desiccated grains may be looked upon as one of the cheapest, most reliable, and most wholesome forms of feeding stuff. They may be either brewery or distillery grains; and, although consisting chiefly of barley, they may contain other grains, as also maize. The source from which the grains have been derived has apparently no great effect on their composition, although brewers' grains resulting from the manufacture of pale ale are usually rather superior to those from stout. The average analysis of dried grains is about 20 per cent. of albuminoids, 7 per cent. of oil, and 45 per cent. of carbohydrates. This represents a composition not very dissimilar from linseed cake; and, judging from experiments, it may be assumed that weight for weight the nutrient constituents of dried grains are about equal to those of linseed cake. That the value of dried grains is becoming more appreciated by farmers is evident from their advance in market price during the past few years.

Judging from their appearance alone one would not be inclined to credit dried grains with very high feeding properties; they are, however, very nourishing and digestible, and are greatly relished by cattle and sheep. They should always be bought on a guarantee, as they offer considerable temptation to adulteration with sweepings, bits of straw, and other low-class material.

A food very similar to the above is Malt Dust, Sprouts, or Combings, often pronounced "Cummins," which consists of the sprouts rubbed off barley malt.

Comparing average samples of dried grains and malt dust, the former is the superior food in about the proportion of 107 to 92; so that about 23 or 24 cwt. of malt dust are equivalent in feeding value to 1 ton of dried grains.

A very exhaustive series of practical feeding experiments, both with cattle and sheep, has been conducted in this country with dried grains, and almost without exception

they have proved more economical than any other concentrated food or mixture of foods. Dried grains alone, or, better still, mixed with decorticated cotton cake, have often proved superior to linseed cake both for cattle and sheep.

The Pulse Grains.—This term includes beans and peas, which must be looked upon as albuminoid foods. Excepting that they are poor in oil (about 1½ per cent.) they are somewhat similar in composition to linseed cake. They are quite different in composition from the cereal grains, which they considerably surpass in feeding properties. The great estimation in which beans and peas, in the form of meal, are held for dairy cows is due to their producing a plentiful yield of milk, and butter of superior quality. Where it is intended to fatten cattle without cake or dried grains, some addition of beans or peas to the concentrated food is considered desirable by many farmers.

Cereal Grains.—These include wheat, barley, rye, oats, and maize, which may all be grouped together as essentially carbohydrate, or starchy, foods. They contain roughly 60 to 70 per cent. of carbohydrates, 10 per cent. of albuminoids, and 2 to 5 per cent. of oil or fat.

The only stock to which wheat is generally given is poultry, and for this purpose it is unexcelled by any food except perhaps, short white oats.

Barley usually commands a price in this country that precludes its being profitably used as a food for farm stock. Inferior samples, unfit for malting, may be used for the same purposes as maize.

Oats are considered the staple food of horses, but where corn has to be purchased, a mixture of beans and maize will often be found cheaper. Such a mixture, in the proportion of about 2¾ of maize to one of beans, constitutes a food very similar in composition to oats, and 16 cwt. of the maize-bean mixture is about equal in feeding value to 1 ton of oats.

Maize is the most starchy food in the market, and is always most appropriately fed with a highly albuminoid food such as decorticated cotton cake. As a concentrated food for general feeding purposes a mixture of equal weights of these two foods can hardly be excelled. The very small quantity of lime, and the low percentage of albuminoids in maize, largely account for its unsuitability as a food for young growing animals. It also gives very unsatisfactory results as a poultry food.

Treacle, or Molasses.—This is a substance which can often be very profitably employed. It contains about fifty per cent. of sugar, and consequently has considerable feeding value, whilst it is much relished by cattle. When mixed with water, and used at the rate of a pound per head per day

to moisten chaff, treacle is a very useful addition to a diet, especially when roots are scarce.

Molasses are now largely employed as a cattle food when absorbed by dried peat (moss litter) or by the pith of the sugar-cane. In this form the food is more convenient to handle than when in a liquid state.

A section of the Revenue Act, 1903, provides that molasses imported into Great Britain and Ireland shall not be liable to duty if intended solely for the purpose of food for stock.

Cod-Liver Oil.—Although cod-liver oil has not yet taken a place amongst the staple foods of the farm, the attention of farmers may be drawn to the fact that several practical experiments have been conducted, showing considerable success from the use of this substance as a food for calves. The function of the oil is to supply the place of cream when rearing calves on separated or skim milk. It is given to the calves after they are about six weeks old, and in quantities up to 2 ozs. per head per day. Calves reared on separated milk and cod-liver oil do not gain in weight so rapidly as those fed on whole milk; but they will, if proper care be exercised, remain perfectly healthy, and they are reared at less than half the cost. It is a great advantage to continue to give the oil for some time after the milk has been stopped. The beef from animals fed in the early stages of their existence on cod-liver oil is in no sense inferior in quality to that from animals reared on whole milk.

4, Whitehall Place, London, S.W.
September, 1902.
Revised, October, 1904.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Root-knot Disease in Cucumbers and Tomatoes.

Cucumbers and tomatoes are often affected by a disease induced by the Root-knot Eelworm (*Heterodera radicicola*).

The first symptom of attack is a drooping and yellowing of the foliage, followed by the stem becoming limp, and a collapse of the entire plant.

The finer branches of the root are more or less studded with swollen portions or "knots," varying in size up to one quarter of an inch across; knots of larger size are also often present on the thicker branches of the root (*see illustration on next page*).

Microscopic examination shows the presence of numerous eelworms in the knots.

The eelworms escape from the knots into the soil, where they remain for a time and then enter the roots of other plants.

There is no method known by which eelworms in the roots of plants, or in the soil in which plants are growing, can be destroyed without injuring the plants.

To destroy eelworms present in soil, it must be thoroughly saturated three times, at intervals of a fortnight, with the following solution:—carbolic acid one part to twenty parts of water.

A second remedy is mixing the soil intimately with gas-lime.

In either instance the soil so treated must remain for at least six weeks before it can be used.

When soil in a house is infested, it is safest to remove the whole and treat it outside; the interior of the house should then be thoroughly washed with carbolic acid one part, water eight parts.

4, Whitehall Place, London, S.W.
November, 1902.

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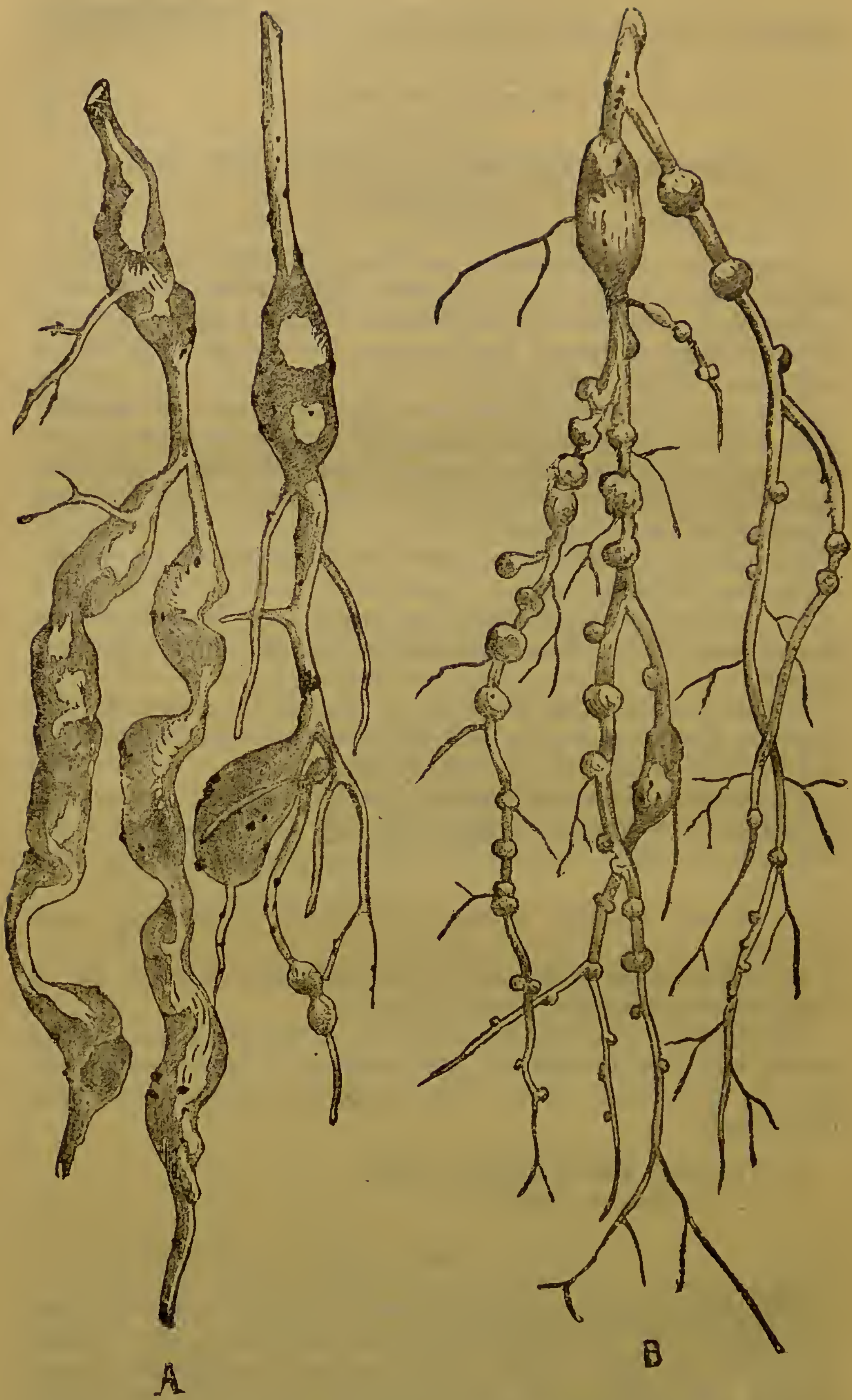

Roots of (A) Cucumber, (B) Tomato, attacked by Root-knot Eelworm.

BOARD OF AGRICULTURE AND FISHERIES.

Cucumber and Melon Leaf Blotch.

Cercospora Melonis, Cke.

This fungus, although first observed and described as a new species so recently as 1896, has spread with remarkable rapidity, and at the present moment is the most destructive parasite with which the cultivator of cucumbers and melons has to contend. In several instances growers report an annual loss of £2,000, whereas others have had to abandon the cultivation of these plants owing to the repeated destruction of their entire stock, in places where the fungus has secured a firm foothold.

The foliage is the part first attacked. At a later stage the fruit often also suffers. The first indication of the presence of the disease is the appearance of a few small, scattered, pale green spots on the upper surface of the leaf. The spots gradually increase in size and also in number, and often run together, gradually passing through grey to a brownish or ochreous colour. If at this stage the upper surface of a diseased spot be examined with a pocket-lens, it will be seen to be covered with delicate upright brown threads, each bearing a conidium at its tip. This represents the fruiting portion of the fungus, the mycelium or hyphae being buried in the substance of the leaf.

The minute conidia or reproductive bodies are carried from diseased to healthy leaves by currents of air, insects, clothing, &c., or by spraying, and if the leaf surface is moist such conidia germinate and the germ-tubes enter the tissues of the leaf directly.

Very frequently a leaf becomes quite dry and crumbles to the ground within twenty-four hours of the first infection. Such dead fallen leaves are much more responsible for the rapid spread of the epidemic than are the conidia which pass directly from one leaf to another.

When the dry fragments of a diseased leaf fall on damp earth, the mycelium present in the tissues quickly commences growth and forms an exceedingly delicate cobweb-like mycelium which runs on the surface of the soil and produces myriads of very minute conidia, which are dispersed

kept well in hand by spraying. To accomplish this end a fair supply of air should be admitted so that the atmosphere is not constantly saturated with moisture. It is wise to spray in anticipation of the disease, using a solution of potassium sulphide—two ounces to three gallons of water, adding two ounces of soft soap.

It is very important that the under surface of the leaves be thoroughly wetted with the solution.

If the disease is present, the soil should also be drenched with the solution.

Diseased leaves should be removed and burned before they decay and fall to the ground.

After a diseased crop has been removed the soil should be thoroughly drenched with a solution of "Jeyes' Fluid," in the proportion of an ounce to a gallon of rain water.

As to the danger of infection arising from spores being conveyed in packing cases as recorded above, no suggestions can be offered ; nevertheless the matter is one claiming the attention of cultivators, and as the wholesale mixing up of such hampers appears to be the rule rather than the exception, it is probable that many diseases other than the one under consideration have by this means been first introduced to a new locality.

4, Whitehall Place, London, S.W.
October, 1902.

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BOARD OF AGRICULTURE AND FISHERIES.

Finger and Toe in Turnips.

(*Plasmodiophora brassicæ.*)

This disease, known also as Anbury, Club Root, and "Grub," attacks most, if not all, crops belonging to the order Cruciferæ, such as turnips, swedes, cabbages, kohl-rabi, rape, radishes, &c., and often proves very destructive. The cause of the trouble is a fungus so small as to be perceptible only by the aid of a strong microscope. This minute organism is capable of existing for years in a quiescent condition in the soil, but when a crop that it can attack is sown upon the ground it enters the fine roots, multiplies rapidly in the tissues, and induces malformation and decay.

Like many other fungoid diseases this is extremely infectious, as may be readily proved by taking some portions of diseased root, or soil from a diseased field, and spreading such material on ground on which cruciferous plants are to be grown. In the great majority of cases such treatment will be followed by an attack of the disease, which, however, in the first year, will be sharply confined to the area thus artificially infected. This shows that finger and toe does not spread from plant to plant through the air, as is the case with many other diseases such, for example, as potato disease. It does, however, readily spread from the first point of attack in various ways; for instance, it may be borne in soil which sticks to the plough, to the wheels of carts or other agricultural implements, or to the feet of workers, horses, or sheep. Suppose that a small patch of turnips in a large field is affected by finger and toe, a certain amount of soil will be borne from this patch and dropped elsewhere on the field every time a plough, harrow, cultivator, or scuffler crosses it, and wherever such soil is dropped a new centre of infection is established. Or the crop may be folded on the land with sheep, and the animals crossing and recrossing the diseased patch will soon bring about infection on a wider area. Under other circumstances the crop may be lifted and carted to the homestead and some of the diseased turnips may get amongst the dung which in the succeeding season may be used to manure a turnip crop on another field, and so the disease may appear where it was

never seen before. Or diseased roots may be spread on a grass field to be consumed by stock, and a year or two later this field may be under turnips, when serious infection may be revealed. The refuse of the root house is a fruitful source of infection on a small scale, and such material should never be put either amongst the dung or on a tillage field.

Prevention and Cure.

Although this disease is widespread and destructive much may be done to limit its ravages. It is practically unknown on soils naturally containing a high percentage of lime. The artificial application of burned lime has long been practised as a preventive, and this substance is still the most effective agent that is known. The usual custom is to apply 5 to 7 tons per acre, the dressing being given in the autumn either six months or eighteen months before a turnip crop is to be grown. On the whole the better of these two systems would appear to be that of applying the lime eighteen months ahead of the turnip crop. Under either the four or five course shift, this will mean spreading the lime on the ley before it is broken up for a corn crop.

Another system is to put on a small dressing, say 1 to 2 tons, directly after a turnip crop is removed. To spread such a small quantity evenly over the land it is necessary first to slake it, and afterwards to fill it into carts, spreading by means of shovels directly from the carts. If a considerable amount of disease is present the dose of lime may be somewhat increased, whereas if the field is sound, or nearly sound, the dressing need not exceed 1 to 1½ tons. In this case the treatment is to be regarded purely as a preventive measure. Although lime applied directly a turnip crop is removed will have no visible effect on finger and toe till the next turnip crop comes to occupy the ground, it may be of material advantage to the intervening crops.

One manifest advantage of applying lime immediately after a turnip crop has been grown is that one can readily see where the disease, if any, has been most destructive, and increase the dressing accordingly. The use of ground lime in small quantities (5 to 10 cwt. per acre) has been extensively tested, but the results do not show that lime in this form is more effective than slaked lime, while it is more costly, and often less pure. Moreover, such a small dressing has but little effect on the disease, though it may have a considerable influence in other ways.

Other forms of lime are more or less effective, though none is so powerful as common burned limestone, which is subsequently slaked before spreading. If gas lime be used it should not be put on later than 18 months ahead. Used in this way at the rate of 3 to 4 tons per acre, it has, first of all, the opportunity of increasing the yield of the corn crop,

and in the following year it gets the chance to act on finger and toe. Chalk has also a preventive influence, though its effects are weaker than those of other forms of lime.

Specimen of Turnip (slightly reduced in size) in advanced stage of attack by Finger-and-Toe.*

Although many farmers appear to think that this disease can only be influenced by the use of lime, there is no doubt that its spread and virulence can be greatly affected in other ways. Attention has already been called to the

* From a photograph lent by the Northumberland Education Committee.

extraordinarily infectious character of the disease, and this fact should always be borne in mind by those who have to deal with affected land. It often happens that, to begin with, the disease appears only in certain small portions of a field, frequently the headlands, and while it is still on a circumscribed area no trouble or expense should be spared to stamp it out. If this be neglected it will soon spread all over the field, and, with careless management, all over the farm. Working the land while out of condition is a fruitful predisposing cause of an outbreak. Land that is soured by want of drainage, or in consequence of a burst drain, frequently exhibits the disease.

Neglecting to keep the land clear of charlock and other cruciferous weeds must contribute to the spread of the disease, for it is in such plants that the fungus lives when a field is not under turnips.

A method of suppressing the disease that is generally successful is to arrange the rotation in such a way that a turnip or similar crop does not occupy the land oftener than once in eight years. In the four-course shift, for instance, it may be possible to put half the fallow break under potatoes or mangolds, and if this is done intelligently turnips will not come on the same land oftener than once in eight years, and this should effectively banish finger and toe. A similar result will be got by keeping land in grass for three or four years. Needless to say, no such method of prevention will have much effect unless farmers also take care to avoid carting diseased turnips or tainted dung on to such fields.

Experiments have shown that acid manures encourage finger and toe, and this fact should be borne in mind in the cultivation of land that exhibits a tendency to this disease. Phosphatic manures to use, under these circumstances, are Basic Slag, Bone Meal, or Precipitated Phosphate.

Of late years several so-called disease-proof turnips have been put on the market, and, though all are certainly not immune from disease, some are markedly resistant.

4, Whitehall Place, London, S.W.,
October, 1902.

BOARD OF AGRICULTURE AND FISHERIES.

Liver Disease of Poultry.

Liver disease, which is the name usually given to tuberculosis in birds, is one of the most common diseases of fowls, turkeys, pheasants, partridges, grouse, pigeons, and other birds brought into relation with domestication. Dr. J. Bland Sutton found this disease to be a common cause of death amongst the birds at the Zoological Gardens, and, as the result of an examination of more than a thousand birds of various species, he was able to say : "The birds which are almost exclusively affected by this disease are those which live on seeds, grain (meaning by grain, barley, maize, oats), and fruit. I have only twice observed it in flesh-eaters. Those which live on fish are exempt from it."

It is a very common cause of loss to poultry owners in most parts of this country. It is evidently just as common on the Continent; it is well known likewise in the United States and in Canada. Reports show that it occurs in Queensland. The disease, therefore, may be said to be world-wide in its distribution.

External Symptoms.

In very many places the disease claims a victim with pertinacious regularity, but towards the end of the year and during the winter the death-rate often becomes alarming. The affected fowls become thin and emaciated, losing greatly in strength and weight, and they are frequently also more or less crippled. The appetite is impaired, they are usually off their food or feed in an erratic manner, and diarrhœa is usually persistent. The comb and wattles are pale and dry, and the mucous membranes are pale, wherever visible. The

birds leave off laying soon as a rule. As a result of the extreme emaciation, which is usually the most important and general characteristic, the bones become very prominent, and the effect may be best judged by passing the hand over the keel of the breast bone.

Anatomical Symptoms.

On opening the bird the owner will find that the external appearances of thinness of the muscles are borne out by taking off the skin. The muscles are pale in colour, thus adding further testimony to the symptoms already noted of anæmia, but the most important and characteristic appearances are seen in the body cavity. The liver is brown in colour, sticky to the touch, and dotted all over with small white spots, or larger spots or patches of a white grey or yellow colour. Lifting up the gizzard, the spleen is almost certain to be found to be affected. It is usually enlarged and beset with small or large tubercles, which frequently project as fat-like tumours from its surface. The intestine and the lymphatic glands of the mesenteries are also often the seats of similar deposits. Tubercles sometimes occur in the skin and the joints, and the local swellings may then be seen externally, and affect the movements of the bird. The other organs of the body, as a rule, are not affected. As a result of the weakness produced by the disease the poultry are more liable to parasitic invasion, and nematode or round worms may be got, for example, in nearly every case, at the blind ends of the cæca.

Cause.

In 1883 Dr. Heneage Gibbes reported on specimens sent to him by Dr. J. Bland Sutton that the tubercles contained bacilli which were indistinguishable from those of tuberculosis. The truth of these observations has since been confirmed by investigations made at home and abroad.

The exciting cause of the disease, then, is a bacillus which may be considered a variety of the bacillus of mammalian tuberculosis. It gains entrance, in practically every case, with the food, or by means of fæces of affected birds. The tendency to the disease is inherited.

Prevention.

The present prevalence of the disease in this and other countries is due to the widespread ignorance as to its nature. The birds which die of the disease are usually thrown

on the dung-heap at a farm, and as the fowls have commonly the run of the place they may often be infected by this means. But the most frequent source of infection is the poultry-house or yard which receives the droppings from affected birds containing the bacilli, and the conditions as regards cleanliness, damp, and absence of sunlight are frequently such as to greatly favour the spread of the disease.

Good ventilation is essential to health, but with the view of keeping up the temperature of the poultry house, so as to stimulate the production of early eggs, the birds are often unduly crowded, and the air supply undesirably restricted.

It is a common but erroneous belief that the disease is caused by the too free use of starchy foods, and especially of maize.

The stock at a place affected with liver disease may be divided into the resistant and the non-resistant. The breeding tends to be done more from the former than the latter, and this natural process of making the stock stronger would be greatly assisted by the owner burning or deeply burying in lime the birds which have died, and improving the condition of the survivors.

To exterminate the disease, however, something more than that is required. A house should be built with a run in a corner of a field apart altogether from the old poultry-yard, or the system of movable houses, with frequent change of position, may be adopted. Then the strong and healthy birds should be carefully selected and put in the new house; and, if any of them show the least indication of disease, they should be at once removed and the house disinfected with chloride of lime ($\frac{1}{4}$ lb. to 1 gallon water), or quicklime, or any other good disinfectant. The resistant birds will in this way be separated from the weaker, and will form a foundation for not only a disease-free but a disease-resisting stock.

The hens which have been left should be killed, with the exception, perhaps, of those about which a favourable doubt may exist, and which may be kept in quarantine and carefully fed in a separate disinfected place. The old house should receive several applications of a thorough disinfectant, and the tainted poultry-run should be heavily dressed with gas-lime. Many months should elapse before the birds are again brought back to their old quarters. Periodical disinfection, cleanliness with regard to house, food and water, good ventilation, and the access of sunlight will largely promote the health and vigour of the stock.

the albuminoid ratio from these figures we multiply 4·3 by 2·5 to bring the fat to carbohydrate value, and add the result (10·75) to the 44·7 of carbohydrate, getting a total of 55·45; then dividing this by the 8 of albuminoids we get as quotient 6·9, or an albuminoid ratio of 1 to 6·9. Expressed in arithmetical form the formula is $(4{\cdot}3 \times 2{\cdot}5 + 44{\cdot}7) \div 8 = 6{\cdot}9$. A ratio is spoken of as narrower or wider according as the difference between the two numbers is less or more; thus, 1 to 4 is a narrower ratio than 1 to 8.

Digestible Constituents in the Commoner Feeding Stuffs.—(Chiefly Wolff's figures.)

Feeding Stuffs.	Albuminoids.*	Fats.	Carbo-hydrates.
	%	%	%
Decorticated Cotton Cake ...	36·9	10·0	18·7
Undecorticated Cotton Cake ..	18·0	5·9	17·7
Linseed Cake	24·7	9·6	29·8
Cocoa Nut Cake	20·0	10·0	40·0
Linseed	20·1	25·2	18·9
Beans	22·0	1·4	50·0
Peas	20·1	1·4	53·0
Dried Grains	14·9	6·4	33·9
Wet (fresh) Grains	3·9	1·3	9·9
Bran (wheat) coarse	10·6	2·4	44·4
Wheat	11·7	1·2	64·3
Oats	8·0	4·3	44·7
Barley	7·7	2·3	57·6
Rice Meal	7·0	10·0	43·0
Maize	8·0	4·0	68·6
Malt Dust (combings) ...	18·5	1·1	48·5
Hay (average meadow) ...	5·4	1·0	40·7
„ („ clover)	7·0	1·2	38·1
Oat Straw	1·4	·7	40·1
Barley Straw	1·4	·6	40·4
Bean Straw	5·0	·5	35·1
Pea Straw	3·2	·5	33·4
Locust Bean Meal	2·7	1·1	74·2
Potatoes...	2·1	·2	21·8
Swedes	1·3	·1	10·6
Turnips	1·1	·1	6·1
Mangolds	1·1	·1	10·0
Treacle (Molasses)	11·8†	—	59·9
New Milk	3·2	3·6	5·0
Buttermilk	4·0	1·1	4·1
Separated Milk...	3·9	·4	4·5
Whey	·8	·1	4·9

* Some of these foods also contain Amides, but as these are comparatively unimportant they are included in the Albuminoids.

† This figure is got by the usual method of converting Nitrogen into terms of Albuminoids, but it is very much above the true figure for the digestible Albuminoids in Treacle.

In devising rations for farm stock the following principles have to be observed :—

1. The albuminoid ratio required by a sucking animal is about 1 to 3½, as in new milk; by milking cows and by half-grown cattle, sheep and pigs, growing and fattening at the same time, 1 to 5 or 6; and by an adult animal simply fattening, or by a working horse, 1 to 8. Adult fattening animals may, however, give good results on widely different albuminoid ratios.

2. Ruminant animals, as cattle and sheep, must have bulky matter in their diets, such as grass, hay, straw, and roots, and are well capable of dealing with crude fibre like that contained in straw and hay. Pigs, on the other hand, require a more concentrated food, and are not adapted for feeding on crude fibre. Horses are capable of digesting corn quite as well as or even better than sheep and cattle, but they make less use than ruminants of the nutrient constituents of straw, grass and hay.

3. Cows require a diet that shall be somewhat relaxing to the bowels, so that, when grass is not available, roots, meadow hay, bran, or small quantities of linseed or treacle have to be relied on for keeping them right in this respect.

4. The bare maintenance diet of a full-grown average-sized horse, ox or dry cow is about 8 lb. to 10 lb. of digestible dry matter a day, on which the animal neither gains nor loses weight. Rather more than this is sufficient for an average-sized adult sheep for a week. When fattening, or working, or when yielding a full supply of milk, these animals will generally eat about half as much again.

It may at once be remarked that although the percentage of digestible constituents, as stated in the foregoing table, has been given to one place of decimals, such fine distinctions are entirely obliterated by the natural variations in the composition and character of the foods themselves, as well as by the peculiarities of the animals consuming them. Then again, although many of the following rations have been calculated with much arithmetical detail, this has been done for the purpose of demonstrating exact principles, and not for slavish imitation. The experimental work of our great agricultural societies, too, has shown that even albuminoid ratios may vary greatly for the same result, though this is true chiefly from the point of view of live-weight increase rather than from the point of view of profit and loss. But

though great nicety of detail need not be insisted on, the composition of the rations may be taken as a general guide in the selection of diets for the various classes of farm animals.

Daily Rations for Cows in Full Milk.

Good pasture grass in May has an albuminoid ratio as narrow as 1 to 4, which two months later is widened to 1 to 7; hence it is seen how excellently adapted grass is for spring-born lambs, calves, and foals, and for milking cows, ewes and mares during the early part of the summer, and why it should be improved for them later on by an addition of more albuminoid matter. Up to the end of June, then, good pastures supply food sufficiently high in albuminoids to enable the cow to milk at her best. By the end of July, however, the albuminoid ratio of grass is only about 1 to 7, and later on still wider, instead of 1 to 5 or 6 (about what is required by a cow in full milk); therefore, in order to bring up the albuminoids to the right standard, the addition of some food, like decorticated cotton cake, is necessary for all summer and autumn calving cows soon after they have calved. Thus :—

Lbs.		Albds.	Fat.	Carbo-hydrates.
104	Grass (in August) ... =	2·08 lb.	·52 lb.	14·68 lb.
2¼	Decorticated Cotton Cake =	·92	·25	·47
			·77 × 2·5 =	1·91
		3·00		17·06

Ratio 1 to 5·7 (nearly).

Commencing with 1 lb. a day in July, the cake would gradually be increased on ordinary pasture to 2½ lb. by the end of August. For cows that have calved in winter and early spring, and by this time are naturally going off their milking, this addition of cake is unnecessary, though it would benefit the land; neither is it necessary when cows are put on aftermath full of clover. Some pastures produce very soft butter in June, and an addition of 1 lb. of decorticated cotton cake, though not otherwise required, would have the effect of considerably improving the consistency of the butter.

In this and the following winter-rations it is assumed that the cow—an average shorthorn weighing from 11 to 12 cwt.—will require about 3 lb. of digestible albuminoids and fully 17 of digestible carbohydrate-equivalent a day, which gives a ratio of 1 to 5·7 (nearly). As cows under similar conditions practically eat in proportion to their weights, these rations may be modified to suit smaller cows by simply reducing the quantity of each food-stuff in a ration

proportionately, and the ratio will, of course, remain the same. Thus, taking an ordinary Ayrshire cow's weight at 900 lb. as against 1,200 of the shorthorn, she will require as a diet three-fourths of the following shorthorn rations; and assuming a Jersey cow to weigh 800 lb. she will require two-thirds of these rations as a daily allowance. This assumption is sufficiently accurate for practical purposes, though, strictly speaking, a small animal requires relatively more food than a large one.

In arranging a cow's ration from home-grown and purchased foods, the farmer will be largely guided by the quantities at his disposal and market prices. He should then, by way of a start, write down approximately the weights of roots, long fodder, and meal that a cow will require, omitting for the moment the highly albuminoid food, and remembering that the roots will be somewhere between 2 and 4 stones, the fodder about 1½ stones, and the "trough" food from 6 to 10 lb., part of which will probably be home-grown corn meal and part a highly albuminoid purchased food. He should next calculate the constituents—albuminoids, fat, and carbohydrates—by the Food Table, and see how much short the albuminoids are of 3 lb., and supply the deficiency by means of the cake or other purchased food. When all is totalled up, he will probably find that a little adjustment of weights is necessary to get exactly the 3 lb. of albuminoids and the 17 lb. of carbohydrates required. Bearing in mind the following points the adjusting will not be difficult, viz., that straw will affect the carbohydrates without materially affecting the albuminoids, that the first eight foods named in the Table mainly influence the albuminoids, and that roots, hay, and corn meals affect both the albuminoids and carbohydrates nearly proportionately. Take a case by way of illustration:—A farmer thinks he can afford his cows 3 stones of swedes a day, to be given in two meals. As far as his fodder is concerned he knows he is somewhat short of hay as compared with straw, and he therefore decides to give one foddering a day of meadow hay and two fodderings of oat straw of about 7 lb. each. About half the trough food he intends to consist of crushed oats, say 4 lb., the remainder of decorticated cotton cake; he then writes down:—

42 lb. swedes.
7 " hay.
14 " oat straw.
4 " crushed oats.

and calculates their constituents by the Table.

Thus, calling the figures pounds, remove the decimal point two places to the left to get the weight in 1 lb. of the food instead of in 100 lb., and multiply by the number of pounds of food taken to get the weight of each constituent in the

weight of food taken—in practice it is better to move the point after multiplying instead of before as has been done here. Then in 42 lb. swedes he gets :—

1·3 × 42 = ·546 albuminoids.
·1 × 42 = ·042 fat.
10·6 × 42 = 4·452 carbohydrates.

For the sake of simplicity disregard the third figure to the right of the point if it be less than five, and if it be five or more add one to the second figure after the point.

In the same way the 7 lb. of hay give :—

5·4 × 7 = ·378 or ·38 albuminoids.
1·0 × 7 = ·07 fat.
40·7 × 7 = 2·849 or 2·85 carbohydrates.

the 14 lb. of straw :—

1·4 × 14 = ·196 or ·20 albuminoids.
·7 × 14 = ·098 or ·10 fat.
40·1 × 14 = 5·614 or 5·61 carbohydrates.

and the 4 lb. crushed oats :—

8·0 × 4 = ·32 albuminoids.
4·3 × 4 = ·172 or ·17 fat.
44·7 × 4 = 1·788 or 1·79 carbohydrates.

The albuminoids now total up to 1·45 lb. which, subtracted from 3, leaves 1·55 lb. to be supplied by means of the decorticated cotton cake. Now 1 lb. of cake contains ·37 of albuminoids, therefore 4¼ lb. will fully supply the deficiency, and we get the following ration :—

Lbs.			Albds.	Fat.	Carbo-hydrates.
42	Swedes	=	·55	·04	4·45
7	Hay	=	·38	·07	2·85
14	Oat Straw	=	·20	·10	5·61
4	Oats	=	·32	·17	1·79
4¼	Decorticated Cotton Cake	=	1·57	·43	·79
				81 × 2·5 =	2·02
			3·02		17·51

Of course, the great advantage of working out a ration in this way is to ascertain exactly the amount of trough food required. This will always include the chief albuminoid food, which is at the same time the most expensive, and the one to be purchased unless peas or beans are grown on the farm. The concentrated foods should be accurately weighed at the commencement, afterwards they may be measured by means of a marked bucket. In actual practice the roots and hay after once being weighed would be guessed at, and the straw would probably be given less carefully than the hay, especially at the night foddering. to satisfy the appetite of beasts more hearty than the others ;

any straw remaining in the morning would be drawn back as litter.

The following points should be borne in mind in connection with the feeding of dairy cows:—(1) The diet should not be monotonous; occasional changes of food during a long winter are advantageous, but these changes should be effected gradually. (2) Swedes, turnips, cabbage, rape, kohl rabi, mangolds, carrots, and parsnips all afford suitable green winter food for cows. For practical purposes these foods are much alike in nutritive qualities, though parsnips, carrots, and moderate sized mangolds are rather superior to the rest. Cabbages, carrots, and mangolds are probably the best where first-rate butter is desired, care being taken, in the case of cabbage, to remove the dead and bruised leaves before feeding. To prevent tainted produce all roots and green food, including silage, should be given immediately after milking. Potatoes, when steamed, are a suitable food for cows; they are much richer in carbo-hydrates than the other foods above named. (3) Mixtures of two or more concentrated foods are more serviceable and more economical than one alone. The amount of concentrated food should, if possible, bear some relation to the quantity of milk yielded. Cows that are in full milk will receive, say, 8 to 12 lb. of a mixture of cake and corn per day, whilst cows that are nearly dry will have their allowance proportionately reduced. (4) The water supply should be adequate and of good quality. (5) Cows should be allowed access to rock-salt. (6) The food requirements are influenced by the temperature of the air. Cattle-houses should be kept at a temperature of about 55° or 60° F. Efficient ventilation, but with the avoidance of cold draughts should be carefully attended to. (7) Feeding should be done regularly and quietly, and the animals should be fed in the same order at each meal. (8) The palatability of the diet should be considered. Upon this point largely depends the amount of food consumed, and with all ruminant animals those that eat most usually thrive best. (9) Both the quantity and quality of a cow's milk are dependent more upon her breeding or natural capacity than upon the food which she consumes. Liberal and careful feeding, exercised upon a cow possessing the required potential capacity, will enhance her useful functions. The feeding, however, affects the quantity of her milk rather than the percentage of solids in it, and in this way good feeding increases the total amount of butter or cheese produced.

The following are types of rations for the different kinds of stock, and for use on different classes of farms. They are given merely as examples and should be modified to suit special circumstances such as the supply and price of feeding stuffs, &c.

Winter Rations for Milk Cows.

(I.) Farm largely Arable.

(*a.*) *Milk Sold.*

Lbs.		Lbs.	
1.—56	Swedes	2.—56	Swedes.
20	Oat Straw.	16	Oat Straw.
5½	Decorticated Cotton Cake.	4	Crushed Oats.
		4¾	Decorticated Cotton Cake.

(*b.*) *Butter Made.*

Lbs.		Lbs.	
3.—42	Swedes or Cabbages.	4.—28	Mangolds or Carrots.
20	Oat Straw.	22	Oat Straw.
4	Crushed Oats, or 3 lb. Dried Grains.	4½	Crushed Oats.
5	Decorticated Cotton Cake.	5½	Decorticated Cotton Cake.

On a farm that is largely arable, roots and straw would be abundant and hay comparatively scarce. Rations 1 and 2 would contain too much swedes to make good butter. No. 2 is specially adapted for a light-land arable farm where turnips would be largely grown, but the straw would be short in growth. No. 4 might be used after the New Year, when the swedes are expended and the mangolds ripe. It would be suitable also for a farm growing plenty of straw, and mangolds and carrots rather than swedes.

(II.) Farm half Arable.

Lbs.		Lbs.	
5.—35	Swedes.	6.—30	Swedes.
7	Hay.	7	Hay.
14	Oat Straw.	14	Oat Straw.
3½	Maize Meal or 4 lbs. Crushed Oats.	4	Cocoa Nut Cake.
4½	Decorticated Cotton Cake.	5½	Bean Meal.

Lbs.		Lbs.	
7.—28	Mangolds.	8.—42	Swedes.
7	Hay.	7	Hay.
14	Oat Straw.	14	Oat Straw.
4	Maize or Barley Meal.	5	Dried Grains.
5	Decorticated Cotton Cake.	3	Decorticated Cotton Cake.

Lbs.	
9.—28	Mangolds.
6	Hay.
11	Oat Straw.
4	Wheat Meal.
8	Bean Meal.

On a half arable farm, one foddering of hay a day could probably be spared the cows, and the more complex the mixture the better it seems to nourish the beast, and the more appetising it is. Of the rations here given No. 5 has invariably proved the best at the Cumberland-Westmorland County Farm for yielding milk, although the ratio of this diet is the same as the others; and this at

once suggests that foods have a subtle influence on each other in the matter of digestibility. It has been discovered that starchy matter added to straw reduces its digestibility, while oily food, if it does not promote, certainly does not check it. No. 9 consists of foods which are largely grown on clays or clay-loams, and is therefore well adapted for use on strong-land farms, and it has the merit of not necessitating the purchase of any imported food. On the other hand, it holds little fat, but contains much starch, and, therefore, in accordance with the statement just made, its straw will not be so easily digested as in diets containing cotton or other oil cake. No. 6 would suit a farm having but few swedes for consumption, and No. 7 is adapted for spring feeding. If the market price of oats were good and maize or dried grains were cheap, it might be more profitable to sell oats and buy these foods.

(III.) Farm about one-third arable.

Lbs.					
10.—28	Swedes, Cabbages or Mangolds.				
14	Hay.				
7	Oat straw.				
4	Maize.	or	5 lbs. Middlings.	or	5 lbs. Crushed Oats.
4	Decorticated Cotton Cake.		3¾ „ Decorticated Cotton Cake.		3 „ Undecorticated Cotton Cake.
					3 „ Linseed Cake.

On this sort of farm hay would be more abundant than in the case of (I) and (II), while roots and straw would be less so. Consequently, the rations included under No. 10 provide for two fodderings of hay and only one of straw, with a smaller quantity of roots.

(IV.) Grass Farms.

Lbs.		Lbs.	
11.—28	Mangolds.	12.—30	Hay.
28	Hay.	6	Bran.
4	Decorticated Cotton Cake	2	Decorticated Cotton Cake.

Lbs.	
13.—28	Hay.
10	Dried Grains.
¼	Treacle.

In preparing No. 13 dissolve the treacle in 2 gallons of hot water, mix with the grains, and serve the next day.

Lbs.	
14.—30	Hay.
2	Maize, Barley, or Wheat Meal.
2	Pea Meal.
2	Decorticated Cotton Cake.
½	Linseed.

Pour 1 gallon of boiling water on the linseed at night. Stir in the meals and cake next day just before serving, adding a little salt.

In reference to Ration 11, which is intended for a clay farm growing strong meadow grass, it is suggested that a

patch of a few acres be ploughed and always kept for mangolds. This root can be grown on the same land year after year quite successfully; one advantage of such a system being that the land is always clean and ready for the crop to be drilled early in the spring. In these rations the laxative element is supplied respectively by the mangolds, bran, treacle, and linseed. Whether the treacle or linseed is absolutely necessary will depend on the nature of the hay. If "herby," that is, containing rib-wort, yarrow, the smaller Umbelliferæ, &c., it may be sufficiently laxative of itself.

The complex mixture of No. 14, with the oil supplied in the cake and linseed, makes it a particularly palatable and digestible diet.

(V.) A Town Dairy.

Lbs.	
15.—24	Hay.
2	Maize Meal.
40	Fresh Grains (wet).

Also rations 12, 13, and 14.

In town cowsheds roots, as a rule, are not used in large quantity, if at all, on account of the expense. To keep the cows' relish for their food keen, so that they may be fit for the butcher as soon as they become dry, it is the custom, therefore, to chaff some portion of the hay, scald or steam it, and mix it with the meal or bran, and thus allow the cows two moist meals between the dry ones. Where roots are consumed this is not necessary, for healthy milking cows have good appetites and seem to thoroughly enjoy the chewing of long fodder when alternated with juicy roots. Malt dust is a useful milk-producing food for mixing with chaff, with or without pulped roots.

Maize germ meal and gluten meal are useful foods for dairy cows, and may be used in quantities up to 4 or 5 lbs. per head per day along with cake. Care should be exercised in purchasing, as materials sold under these names are found to vary greatly in nutritive properties. They are both products of maize and differ chiefly in the fact that the gluten meal is richer in albuminoids and poorer in carbohydrates than the germ meal.

Fattening Rations for Adult Cattle.

Some of the more general observations made respecting the feeding of dairy cows apply equally to the feeding of fattening cattle. Good feeding is attended with the best results only when exercised upon animals of a good feeding kind. All varieties of roots and green food are suitable for fattening cattle, and may be fed in quantities up to one cwt. per day. The feeding value of the different kinds of roots and of the same kind grown under different conditions

varies very greatly; this fact, together with a similar variation in the quality of straw and hay, enables farmers in some districts almost to dispense with cake and corn, whilst those in other districts are compelled to employ these foods very largely. In the rations given below swedes might be replaced by white or yellow turnips or by cabbages in autumn, and by mangolds in spring.

The so-called fattening period generally occupies about four months, and it is usual to increase the allowance of concentrated food as the process continues. The animals usually receive about 2 or 3 lbs. cake and as much corn per head per day during the first month, this allowance being increased by 2 lbs. at each consecutive month, making about 10 or 12 lbs. of mixed cake and corn per head per day during the last month. In the rations given below the quantities of food are about the average for the whole fattening period, and are therefore greater than is necessary to start with, and less than is desirable to finish with.

The term adult may here be taken to apply to cows and 3-year-old bullocks. For such cattle an albuminoid ratio of 1 to 8 has been found very suitable, so that 2¼ lb. of digestible albuminoids and 18 lb. of digestible carbohydrates would form a good ration. The following are arranged on this basis:—

Lbs.			Albds.	Fat.	Carbo-hydrates.
1.—100	Swedes	=	1·30	·10	10·60
16	Oat Straw	=	·22	·11	6·42
2	Decorticated Cotton Cake	=	·74	·20	·37
				·41 × 2·5 =	1·02
			2·26		18·41

Lbs.
2.—100 Swedes.
14 Oat Straw.
4¼ Undecorticated Cotton Cake.

Lbs.
3.—56 Swedes.
20 Oat Straw.
4½ Crushed Oats.
2½ Decorticated Cotton Cake.

Lbs.
4.—42 Swedes.
7 Hay.
14 Oat Straw.
4 Maize Meal, or 5 lbs. crushed Barley.
2½ Decorticated Cotton Cake.

Lbs.
5.—28 Swedes.
14 Hay.
14 Oat Straw.
2½ Crushed Grain.
3 Linseed Cake.

Lbs.
6.—28 Swedes.
14 Hay.
10 Oat Straw.
4 Cocoanut Cake.
3½ Crushed Barley, or 3 lbs. Maize Meal.

Lbs.
7.—30 Mangolds.
8 Hay.
16 Oat Straw
4½ Wheat Meal.
3½ Bean Meal.

Lbs.
8.—28 Hay.
5 Maize Meal, or 6 lbs. Barley or Rice Meal.
2 Dried Grains, or 2½ lbs. Malt Dust.
¼ Linseed.

Rations 1, 2, and 3 are adapted for farms mainly under the plough, the first two being specially applicable to Scotland, where swedes and oat-straw possess higher feeding value than is the case further south. No. 4 is for a farm half tillage and half grass, Nos. 5 and 6 are for one having about one-third of its land arable, No. 7 is for a farm of strong land where only home-grown foods are used, and No. 8 for a grass farm. As decorticated cotton cake contains a much higher percentage of albuminoid matter than any other cake, less of it is required to level up a food like straw, which is very deficient in albuminoids, to the standard ratio. Being also as a rule somewhat cheaper than linseed cake, rations containing it as the chief nitrogenous food-stuff can be more cheaply compounded than those containing linseed cake. Preference is also here given to cotton cake for butter-making rations, as it produces a firmer, less greasy, and more palatable butter than linseed cake. For finishing off fat cattle linseed cake, however, imparts a "bloom" and "touch" which appear to be incapable of attainment with any other food. For this purpose the cake used should be specially rich in oil. For cattle up to a year old, and sheep up to 6 or 7 months, linseed cake is much the safer one to use, nor should cotton cake be given in large quantities to cows within 3 or 4 months of calving.

In barley-growing districts, barley straw would probably take the place of oat straw in these rations; not being so digestible, as a rule, some allowance can be made by increasing the quantity of meal used. In the rapid feeding of cattle for the fat market it is more necessary to resort to chaffing, scalding, and mixing of foods, than in feeding cows for milk; the craving for food is keener in the latter than in the former, and fattening cattle are found to eat straw that has been chaffed, mixed with pulped roots, and allowed to lie a day before being eaten, or chaff scalded and mixed with meal of some kind, and a sprinkle of treacle, better than in the long dry state. Also, where no roots are available, some hay-chaff scalded or steamed and mixed with the meal or other trough food, and given alternately with long hay, induces the cattle to eat with more relish. Cattle spices or condiments are often used for the same purpose.

Rice meal, when genuine, is a sound and economical food for fattening cattle, and may be used in quantities up to 4 or 5 lbs. per head per day, along with cake. Barley bran also is a food that is used by some feeders with good results

Rations for Young Cattle.

Calves should be kept on new milk for the first two weeks of their lives, thereafter they may be put on to mixed

new and separated milk. After the fourth week they begin to nibble at hay, and can be well kept on 2 gallons of separated milk a day to which is added 3 tablespoonfuls (2 oz.) of cod liver oil. At 10 weeks the oil may be discontinued, and the calf will then have to depend mainly on the carbohydrates of the hay for the heat and fat producing matter of its food. A little linseed cake, meal, and pulped swedes in winter, or grass in summer, should gradually be introduced, so that at 6 months old milk may be altogether discontinued if necessary. The calf will now thrive well up to a year old on 1 to 1½ lb. of mixed linseed cake and meal, 4 lb. or more of hay, and 3 to 10 lb. of swedes (or grass in summer) a day, which will give an albuminoid ratio of 1 to 4½ or 1 to 5 according to the proportion of hay and roots eaten. On milk-selling and cheese-making farms, however, separated milk is not available, and recourse has to be had to milk substitutes or calf-meals to rear the heifer calves intended for breeding. There is no difficulty in compiling from our food table a meal that shall closely resemble milk in its digestible constituents, but it cannot be done without at the same time introducing a much larger amount of indigestible matter than occurs in milk; this, and the question of choosing meals that will agree with the calf's stomach, constitute the practical difficulty of rearing calves without milk.

The following meals have proved to be good milk substitutes, giving an albuminoid ratio about the same as that of new milk:—

Calf Meals.

1.—Linseed Cake Meal, 14 parts by weight.
Crushed Linseed 5 " "
Wheat Flour 2 " "
Locust Bean Meal 2 " "

Mix 3 lb. with 5 qts. of boiling water and a sprinkle of salt, say ¼ oz., for the day's allowance of one calf—given at three meals under three months old, and at two meals above that age.

2.—Linseed Cake Meal, 2 parts.
Oatmeal 2 "
Crushed Linseed 1 "

Mix 3 lb. with 5 qts. boiling water over night, and stir and boil for 10 minutes next morning, serve at three or two meals with salt and 2 oz. of sugar.

Where a small quantity of separated or skim milk is available:—

3.—8 parts of Oatmeal.
1 part of Crushed Linseed.

Scald $2\frac{1}{4}$ lb. over night with 5 pints of boiling water, boil for 10 minutes next morning, and add 5 pints of separated milk with about $\frac{1}{4}$ oz. of salt and 2 oz. of sugar, for one calf per day.

Weaners on grass require no more than from $\frac{1}{2}$ to $\frac{3}{4}$ lb. mixed linseed cake and meal each per day in addition to grass to keep them in good thriving condition.

Yearling bullocks that are intended to be house-fed for early beef of, say, about 8 cwt. live weight at about 19 months old, should have the diet recommended for calves rising a year old, steadily increasing until they finish with two-thirds of the ration of a full-milking shorthorn cow. The same feeding is suitable for fattening Irish heifers.

At about 15 months old the fattening yearling would in this way be receiving a diet like No. 4 ; and at 18 or 20 months of age, when finishing for the butcher, a ration like No. 5 would be suitable. The albuminoid ratio in both cases is about 1 to 5.

4.—21 lb. Swedes.
7 „ Hay.
2 „ Oats.
3 „ Linseed Cake.

5.—37 lb. Swedes.
10 „ Oat Straw.
3 „ Maize, Barley, or Wheat.
3 „ Linseed Cake.
2 „ Decorticated Cotton Cake.

Yearling store bullocks and heifers turned out to grass in the spring require no extra food, but should come in full of flesh in late autumn. For wintering yearling stores a liberal allowance of turnips and straw, with from 2 to 4 lb. per day each, according to size, of mixed decorticated cotton cake and meal, should be given in order to produce well-grown and "fresh" beasts for the spring store sales. If, however, they are intended for the fat market in the new year, when close upon two years old, they will require more liberal feeding, and by the beginning of December will pay for a ration of five-sixths that of a cow in full milk, such as :—

6.—42 lbs. Swedes.
14 „ Oat Straw.
3 „ Maize Meal or 4 lbs. Crushed Barley or Rice Meal.
4 „ Decorticated Cotton Cake or 5 lbs. Linseed Cake.

7.—42 lbs. Cabbages or Yellow Turnips.
7 „ Hay.
6 „ Straw.
4 „ Crushed Oats.
6 „ Dried Grains
or
3 lb. Crushed Oats.
5 „ Dried Grains.
$\frac{1}{4}$ „ Linseed.

8.—22 lbs. Mangolds.
18 „ Oat Straw.
4 „ Crushed Oats.
$4\frac{1}{2}$ „ Decorticated Cotton Cake.

As it is mainly on arable farms that winter feeding is followed, roots, straw and corn will for the most part form the home-grown contributions to the rations.

Rations for Sheep.

In Scotland and over a large portion of the north and west of England ewes wintering on grass require no more than a rack of hay, and generally get mangold and turnip-tops thrown out to them, and are run over the root land, after the roots have been pulled and carted off, to clean up small ones and stray leaves. As soon as they lamb they require a ration with an albuminoid ratio of about 1 to 6 to keep up their milk supply and flesh. This is generally provided in the first three months of the year by means of swedes or mangolds, bean or pea straw, or mixed hay and straw chaff (oat or barley) and peas, linseed cake, oats, bran, &c.

The following rations supply the requirements of seven ewes for one day, or one ewe for a week ; the quantity and quality of the digestible matter is almost the same as that of the cow rations, but as the ewe will get nearly all her water from the roots supplied, something like three times as many are given her for a week as to a cow for a day :—

Lbs.			Albds.	Fat.	Carbo-hydrates.
1.—120	Swedes	=	1·56	·12	12·72
5	Hay and Straw Chaff ...	=	·17	·04	2·02
5	Linseed Cake	=	1·24	·48	1·49
				·64 × 2·5 =	1·60
			2·97		17·83

Lbs.		Lbs.	
2.—120	Swedes.	3.—80	Mangolds.
2	Pea Straw.	6	Hay.
2	Hay.	6	Oats.
6	Peas.	5	Bran.
		2	Decorticated Cotton Cake.

When the ewes and lambs are put on a good spring pasture they no longer require trough feeding ; but should they be inclined to scour it would be well to continue oats for a while. As the ewe's milk diminishes the lambs should be kept progressing after July with about a pound of linseed cake or cracked peas to every seven lambs per day. When ewes or lambs are placed on clover aftermath they fatten without auxiliary food.

In the case of the various "Down" breeds of sheep in the south of England, lambing usually takes place in January. After lambing the ewes and lambs are folded on roots, and the ewes are allowed about 1 to 1½ lb. of sainfoin or meadow hay per day, and about the same quantity of concentrated food, consisting, say, of linseed cake, peas and

pollards, or dried grains and oats. During the spring months the sheep are folded on rye, trifolium and rape, with an allowance of mangolds. In summer the fold will be vetches and rye grass, and in autumn rape, with a run each day on old leys. As the lambs become independent of milk, the allowance of concentrated food to the ewes is gradually dropped. Dried grains is an excellent food for ewes, and an admixture of malt dust with hay chaff not only supplies extra nourishment, but also renders the chaff more palatable.

Fattening Sheep.

The following points should be considered in the successful fattening of sheep:—(1) A mixture of two or more concentrated foods is better than one concentrated food alone; (2) The allowance of cake and corn should be gradually increased as the fattening process continues, commencing with, say, 2 lb. per head per week, and finishing with, say, 6 to 10 lb. according to the size of the sheep; (3) A monotonous diet should be avoided, and this refers to both green food and trough food; (4) The greater the amount of bulky food consumed, the more rapid and economical will the fattening process be.

Hoggets (tegs) are extensively fattened during the winter on turnips or swedes, and experience has shown that the fattening is done much more economically, and with fewer losses by death, when dry foods are given with the roots, and the roots cut and measured out to the sheep. The cutting of roots is a much commoner practice in the north than in the south.

Young sheep fattening for the butcher usually consume from 100 to 160 lb. of roots or green food, such as cabbages or rape, per head per week, and from 3 to 8 lb. of hay, or hay and straw. The consumption of concentrated food varies from 2 to 10 lb. per head per week, being on the average about 5 lb. The following is a typical weekly ration for a fattening sheep belonging to one of the larger breeds, such as Hampshire Down or Leicester.

Lbs.			Albds.	Fat.	Carbo-hydrates.
120	Swedes	=	1·56	·12	12·72
5	Hay and Straw Chaff ...	=	·17	·04	2·02
3	Barley	=	·23	·07	1·73
2	Decorticated Cotton Cake	=	·74	·20	·37
				·43 × 2·5 =	1·0
			2·70		17·91

Ratio 1 to 6·6.

The following are examples of suitable mixtures of concentrated foods to be given along with green food (including roots) and hay, or hay and straw. The quantities are suitable for one sheep for a week, on the average of the fattening period.

3 lb. Maize Meal (or Rice Meal).
2 ,, Decorticated Cotton Cake.

3 ,, Dried Grains.
2 ,, Decorticated Cotton Cake, or Linseed Cake.

2 ,, Malt Dust.
2 ,, Maize Meal, or Crushed Barley.
1 ,, Decorticated Cotton Cake, or Linseed Cake.

3 ,, Wheat, or 2 lb. Wheat.
1 ,, Malt Dust.
3 ,, Undecorticated Cotton Cake.

3 ,, Peas.
2 ,, Dried Grains, or Cocoa Nut Meal.

Where sheep are growing rapidly, and at the same time putting on flesh—such as is the case with ram lambs to be sold for service at about eight months old—there must be plenty of variety in the diet, and the trough food must be rich in flesh-forming material. A good mixture for this purpose is linseed cake and peas, with or without malt dust.

In certain parts of Scotland sheep are regularly fattened without the addition of hay or straw to the ordinary diet of turnips and cake, &c. The high quality of the roots grown in these districts largely accounts for the success of this system. Where there is a good market for hay, a modification of the system could be followed in other parts of the country by substituting dried grains for a portion of the hay, or by giving dried grains and straw chaff instead of hay.

Rations for Pigs.

The following mixtures of food rations have been used with pigs fed from 10 weeks old, for a period of 18 to 20 weeks, and making from 16 to 18 stones dressed weight. Each has an albuminoid ratio of 1 to 6, and consists of food-stuffs ordinarily used in pig feeding to meet varying farm conditions. The daily allowance will be regulated by the age and size of the pig.

1. 6 lbs. of maize meal to 1 gallon of separated milk.
2. 2 lbs. of maize meal to 1 lb. of pea meal.
3. 6 lbs. of middlings to 1 lb. of pea meal.
4. 6 lbs. of boiled potatoes, 3 lbs. of ground oats, to ½ gallon of separated milk.
5. 5 lbs. of ground oats, 1 lb. pea meal to 1 gallon of whey.

The meal is scalded in bulk and mixed with separated milk, whey, or water as the case may be, at the time of

serving. The pigs are fed three times a day with as much as they will "clean up" each time.

In many parts of the country the most saleable pig is one weighing about 160 lb., or 8 scores dead weight, and this should be attained when the animal is about 8 months old. The pigs are weaned at about 2 months, and for the next 3 months are kept in rapidly-growing store condition. They should be given cooked roots or vegetables of some sort every day, and in addition should receive a thin wash comprising a fair proportion of flesh-forming matter. The diet should have a ratio of about 1 to $4\frac{1}{2}$ or 5.

The following are examples of suitable mixtures of foods for weanling pigs :—

1. Separated milk or butter-milk, barley meal, and bran or pollards. If 1 gallon separated milk be allowed, the meal and bran would be mixed in the proportion of 5 to 1.
2. Separated milk or butter-milk, maize meal, and bean or pea meal. With 1 gallon separated milk the maize and bean meals would be in the proportion of 4 to 1.
3. Separated milk or butter-milk, maize meal, and wheat meal. The meals in proportion of 3 of maize to 1 of wheat.
4. Whey or house wash, barley meal, and bean or pea meal. With 1 gallon whey the meals will be in the proportion of 2 to 1.
5. Whey or house wash and ground oats.
6. Brewers' grains (fresh), barley meal, and bran or pollards.

Compared with whey, separated milk and butter-milk are both rich in flesh-forming constituents. A mixture of whey and maize meal would be quite unsuitable unless fortified by, say, bean or pea meal.

With regard to the quantity of food required, young pigs of 3 or 4 months old will consume about $3\frac{3}{4}$ lb. of dry food per 100 lb. live weight per day. This quantity of dry food would be supplied by 1 gallon separated milk and about 3 lb. of meal.

After pigs have attained the age of about 5 months the feeding is of a more forcing nature, and from this time the fattening process continues till the animals are slaughtered at the age of 8 or 9 months. The quantity of food required is represented by about $3\frac{1}{4}$ lb. of dry feeding substance per 100 lb. live weight per day, and in order to produce a fair proportion of lean flesh the diet should have an albuminoid

ratio not wider than 1 to 6. The allowance of meal should be gradually increased, and the food should be given of thicker consistency as the fattening proceeds. A pig of 160 to 180 lb. live weight will require about 6 lb. of meal per day, or its equivalent in meal and dairy refuse. The following are suitable daily rations for pigs of this kind :—

1. 5 lb. barley or maize meal, 3 lb. potatoes, 1 gallon separated milk or butter-milk.

2. 6 lb. barley or maize meal, 1 gallon separated milk or butter-milk.

3. 4 lb. barley or maize meal, and 2 lb. bean or pea meal.

4. Equal quantities each of bean, maize, barley, and wheat meals.

5. Barley and wheat meals in the proportion of 5 or 6 of the former to 1 of the latter, with separated milk or butter-milk, and in the proportion of 3 or 4 to 1 with whey or wash.

Pig-sties should be kept warm and dry, as the pig is very susceptible to cold or damp.

Well-bred pigs slaughtered at, say, 8 or 9 months old will weigh usually about 200 to 212 lb. live weight, and they will yield 75 to 80 per cent. of carcase meat.

It is considered that a pig thriving well should yield about 1 lb. of dressed meat for every 5 lb. of meal consumed.

Rations for Horses.

In France and Germany experiments have been conducted for the purpose of ascertaining what constitutes a bare maintenance diet for a horse of 1,000 lb. weight when absolutely at rest ; and it was found that 8 lb. of digestible matter, with an albuminoid ratio of about 1 to 8, was sufficient. Good hay alone will give this ratio. As, however, in practice there are but few days in which farm horses will be kept entirely in the stable, and cart horses are usually heavier than 1,000 lb., we may take 10 to 12 lb. of digestible organic matter as about the maintenance diet of a farm horse when not at field work or carting. An average sized farm horse at ordinary work will require a ration supplying about 27 lb. total dry matter. The food should contain, say, 2 lb. of digestible albuminoids and 15 lb. of digestible heat formers, and should have a ratio of about 1 to $7\frac{1}{2}$. The quantity of food required can be readily calculated from the assumption that hay and corn contain about 85 per cent. and 88 per cent. of dry matter respectively.

The following is probably the simplest example of a daily ration for a farm horse :—

Lbs.		Albds.	Fat.	Carbo-hydrates.
1.—20 Hay	... ... =	1·08	·20	8·14
12 Oats	... ... =	·96	·52	5·36
			·72 × 2·5 =	1·80
		2·04		15·30

Albuminoid ratio 1 to 7½.

As a rule, however, a simple diet like the above is not the most serviceable. With a more complex diet the animals will be found to thrive better, and in many cases also the expense is reduced.

It is economical to chaff hay for horses, as they frequently waste it by littering when supplied long in the rack, though possibly one given to bolting food would chew it better in the long state. All corn should be crushed or bruised. The feeding should be done regularly with avoidance of long fasts. Occasional changes of food are advantageous, and during busy times when horses are working long hours at heavy work the diet should be of a concentrated character, as horses do not derive the same amount of nourishment from bulky foods that cattle do. In the neighbourhood of London, where farm horses are frequently engaged almost continuously in carting hay and straw to market, it is not unusual to allow as much as 25 lb. per head per day of oats, with only a small quantity of hay chaff. A mixture of maize and beans in the proportion of 2¾ of the former to 1 of the latter gives about the same albuminoid ratio as oats, and it will be found that 15 lb. of the maize-beans mixture affords the equivalent amount of nourishment to 19 lb. oats.

The following are examples of suitable daily rations for farm horses at average work :—

Lbs.	Lbs.	Lbs.
2.—18 Hay.	3.—12 Hay.	4.—18 Hay.
9 Maize, or partly Barley.	5 Oat Straw.	12 Oats.
2 Bran.	6 Oats.	2 Beans.
2 Beans.	6 Maize.	
	3 Beans.	

A full ration for a horse at the busiest time of the year would be :—

Lbs.
5.—9 Oat Straw.
6 Hay.
12 Oats.
3 Beans or Peas.
1½ Linseed.

Farm horses fed on oat straw and oats alone—the plan followed in many northern and western districts—require a very variable quantity of oats, depending upon the character of the straw, which in some localities has a high nutritive value, whilst in others its quality is very low. In any case the oat straw is given *ad libitum*, and the quantity of oats required to supplement it will vary from 14 to 24 lb. according to the quality of the straw, the quality of the oats, the size of the horse, and the character of the work to be done.

Horses that are not at work can be maintained on hay alone, of which they will require about 23 lb. per head per day. Such a diet, however, fails to keep up that "hard" condition which is necessary if the horse is to be fit for work when called upon. A more suitable ration for an idle horse is :—

	Lbs.		
6.—	8	Oat Straw.	
	6	Hay.	
	5	Maize (or Maize and Barley)	or 8 lbs. Oats.
	2	Beans	

Carrots, swedes, and mangolds are much relished by horses; they are very suitable for idle horses, but to those in work they should not be given in quantities greater than about 8 or 10 lb. a day. A sick horse will often be tempted to eat a few carrots when it will touch no other food.

Mares suckling foals find all the nourishment they require in an early summer pasture; should an indoor ration be required for a mare with a foal, the following is a very suitable one, the albuminoid ratio being about 1 to 6·3 :—

	Lbs.	
7.—	21	Hay.
	4	Maize Meal.
	5	Oats.
	3	Bran.
	3	Beans.

Half the hay might be given long, the other half should be chaffed and mixed with the maize meal and bran damped, and the oats and the crushed beans given dry. In feeding horses it is a safe rule to remember the saying "*old* oats, *old* hay, and *old* beans long crushed."

The foal will graze with the mare and soon share with her any indoor food she may be getting, and thus prepare itself for weaning. When weaned it should get a little trough food, consisting of oats ½ lb., and linseed cake ¼ lb. a day. It would probably be wintered out on the pastures in the

day time, and in a shed or well-aired loose box at night; when brought in at night it should be supplied with a rack of hay and one of the following trough mixtures:—(1) 1 lb. of oats and ½ lb. linseed cake, or (2) ½ lb. oats, ½ lb. bran, and ½ lb. crushed beans. The oats should be crushed or bruised.

4, Whitehall Place, London, S.W.,
February, 1903.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

The Use of Artificial Manures.

Some of the points that a farmer may with advantage consider in purchasing artificial manures are set forth in Leaflet 72. The present leaflet is designed to supply practical information in regard to the use of these substances.

In giving general recommendations on the subject of manuring, it is to be borne in mind that, although the advice offered may be serviceable in the majority of cases, it will certainly not be applicable to exceptional circumstances. Farmers who manure on general principles will, no doubt, usually be right, but those who are dealing with soil of an exceptional character, or with a farm that has been managed in an exceptional manner, may be led very far astray by blindly following general principles. Take, as an example, the manuring of meadows. The teachings of Rothamsted, and of several other experimental stations, show that, as a rule, potash is a most important ingredient in a manurial mixture, and yet there are cases where this substance does harm rather than good when used for meadow hay. Or take the effects of this substance on the turnip crop. As a rule it is necessary, and its use will leave a profit, though it cannot be said that, in the majority of cases, its presence or absence is a matter of vital importance. But there are cases where potash is the most important element of all in the treatment of this crop; so much so, indeed, that the most liberal applications of nitrogen and phosphates may be absolutely without effect if unsupported by potash.

It is, therefore, the first duty of a farmer to ascertain what the manurial requirements of his own particular holding may be. And not only so, but, if his land is variable in character, he should take steps to become acquainted with the peculiarities of every field. To rest satisfied with less is to conduct his business in a haphazard fashion. His practice may be right, but there is a great chance that it will be wrong, and a serious error in judgment may result in heavy pecuniary loss. To some it may seem an extreme recommendation to make that every farmer should be an experimenter, but nothing less will meet the necessities of the case. What with the extra labour involved in measuring

and weighing, and the loss in yield that some of the methods of treatment may entail, experimenting cannot be done without expense; but for ordinary practical purposes five pounds will go a long way towards obtaining information that may be worth many times this sum. The land must be measured, and the manures must be weighed and properly mixed and applied, and although the experiment cannot be said to be complete till the produce has been weighed, an experienced farmer can often estimate with the eye with sufficient accuracy what the result of his experiments has been.

The set of experiments known as "The Eight Plot Test" is that which gives the greatest amount of information for the number of plots involved. It supplies four answers to each of the three questions: Shall I use (*a*) Nitrogen? (*b*) Phosphate? (*c*) Potash? It may be carried out with any nitrogenous manure (*e.g.*, nitrate of soda or sulphate of ammonia), with any phosphatic manure (*e.g.*, superphosphate or basic slag), and with any potassic manure (*e.g.*, kainit or sulphate of potash). Suppose that the first-mentioned of each of these pairs is employed, and that the crop is turnips, the eight plots may be treated per acre as follows:—

1. No manure.
2. 1 cwt. nitrate of soda.
3. 5 cwt. superphosphate.
4. 3 cwt. kainit.
5. 1 cwt. nitrate and 5 cwt. super.
6. 1 cwt. nitrate and 3 cwt. kainit.
7. 5 cwt. super. and 3 cwt. kainit.
8. 1 cwt. nitrate, 5 cwt. super., and 3 cwt. kainit.

When the crop is mature, it will be possible to ascertain the effects of nitrate as follows:—

Compare Plots 1 and 2 for the result of using nitrate alone.

Compare Plots 3 and 5 for the result of using nitrate with super.

Compare Plots 4 and 6 for the result of using nitrate with kainit.

Compare Plots 7 and 8 for the result of using nitrate with both super. and kainit.

Similar information may be got for super. by taking the plots as follows:—1 and 3, 2 and 5, 4 and 7 6 and 8; and for kainit by taking Plots 1 and 4, 2 and 6, 3 and 7, 5 and 8. By omitting three plots (2, 3, 4), and having only five (1, 5, 6, 7, 8), information sufficiently serviceable for many purposes will be obtained, for the test will show the effect (*a*) of using a general mixture (compare Plots 1 and 8), (*b*) of omitting nitiogen (compare Plots 8 and 7), (*c*) of omitting phosphate (compare Plots 8 and 6), (*d*) of omitting potash (compare Plots 8 and 5). By adding a few plots to either of

these sets, supplementary information may be got in regard to the best kind of nitrogen, phosphate, or potash; and, further, as to the best quantity.

Manurial Treatment of the More Important Crops.

The basis of all systems of manuring should be dung. This does not mean that this substance should be applied concurrently with artificial manures, but merely that land from which crops are taken should periodically receive a fair dressing of this fertilizer. Where straw, hay, and roots are consumed on a farm, enough dung will be produced to allow of about one-fourth or one-fifth of the area of arable land and meadows being dressed annually with 10 to 15 loads per acre. As regards the arable land, the dung is applied in some districts to the roots (North of England, Wales, Scotland), in others it is given to the wheat (where bare-fallowing is practised), while elsewhere it may go on to the barley stubble for the seeds hay (Suffolk), or be used in other ways. Although on land that naturally grows strong straw the supply of dung may alone maintain a farm in fair fertility, it seldom, if ever, happens that the home-made supplies suffice to produce maximum crops throughout a rotation. For this reason it is found to be profitable to purchase artificials, which, however, should be regarded as a supplement, not as a substitute, for the natural fertilizer. The larger crops that these artificials produce mean, of course—if the crops are consumed at home—a larger dung-heap, so that when once a farm has been brought up to a high state of fertility it is prudent to curtail the manure bill.

Cereals.

Wheat receiving 10 loads or upwards of dung per acre seldom needs artificials, and the same is usually true where this crop follows a well-dunged root crop, or a good clover root. Where artificials are used, nitrogen is the most important element, and, as wheat usually occupies strong land, nitrate of soda (1—2 cwt. per acre) is preferable for use in spring to either sulphate of ammonia or organic manures. Sometimes it is desirable to help a weak plant in autumn, and then 1 cwt. of sulphate of ammonia or 2 cwt. of rape dust or fish meal may be used. The residues from applications of phosphates to the root crop usually make the direct use of such manures for wheat unnecessary. On the lighter classes of wheat soils, and especially in the later districts, 2 cwt. per acre of superphosphate applied in autumn, by improving quality and hastening maturity, may be profitable. Potash is practically of no importance in the manurial treatment of this crop.

Barley responds readily to nitrogenous dressings, but as it is easily laid, and is often put in with "seeds" which thrive best under a light crop, it is not often top-dressed. Moreover, barley generally follows a well-manured root crop, often folded with sheep, so that the land is in good condition. It is also to be remembered that the grain is apt to be horny or flinty when grown with too much nitrogen, so that an increase in yield may be more than discounted by a reduction in quality. A fine sample of barley, though a small yield, is often got after a wheat crop, largely because the soil is thereby to a great extent depleted of its surplus supplies of nitrogen.

If the field is in low condition, and especially if a short-stemmed, stout-strawed variety is grown—more particularly in a district where the best class of brewing barley cannot be hoped for—a moderate dressing of nitrogen may be given; and, as barley soils are usually light, sulphate of ammonia ($\frac{3}{4}$—1 cwt. per acre) will suit better than nitrate of soda. To improve the quality, though also to add to the bulk, both phosphates and potash may frequently be used with advantage, but it is very necessary for the farmer to determine the point by experiment. On typical barley soils dissolved bones and Peruvian guano are also suitable. A barley manure may therefore consist of about (per acre):—

$\frac{3}{4}$ cwt. sulp. ammon. } or 3 cwt. dis. bones
2 cwt. super. } or $1\frac{1}{2}$ cwt. Peruvian guano
2 cwt. kainit

All of which may be mixed together and applied with the seed.

Oats are often grown on the poorest classes of tillage land, and, moreover—coming, as they do in many cases, before roots, and therefore removed as far as possible from the point in the rotation when dung is used—they find but small supplies of food in the soil. They are often, too, sown after land has been some years in grass, and when, consequently, there is a tough sod; and a heavy straw crop can do much to mellow the soil and make it work down kindly for the following root crop. If, as is often the case, oats are grown in a wettish district, sulphate of ammonia (say 1 cwt. per acre) may be used. In other cases, and especially if a weak plant is to be helped by top-dressing, nitrate of soda (1—$1\frac{1}{2}$ cwt.) will be more serviceable. Phosphates will not usually add much to the bulk, but they will make harvest somewhat earlier, and in a typical oat district this is of importance. Two cwt. of superphosphate may therefore often be used with advantage. Only on very light land is it likely that potash will pay on this crop.

Rye is too unimportant to be treated in detail, but as it is usually grown on the lighter and poorer soils it may be treated as for oats.

Maize is now grown to a considerable extent for fodder. It should either follow a well-dunged root crop or receive a moderate direct dressing of dung. In either case the artificials may consist of 1 to 2 cwt. of nitrate of soda or sulphate of ammonia, and 2 to 3 cwt. of superphosphate.

Green and Root Crops.

Mangolds: the basis of manuring for this crop should be dung, applied in autumn if land clean, or in spring. Supplementary to this manure a mixture of artificials, such as 1 cwt. sulphate of ammonia, 3 cwt. superphosphate, and 4 cwt. kainit should be given at the time of sowing, with 1 cwt. or $1\frac{1}{2}$ cwt. of nitrate of soda as a top-dressing at the time of thinning. Half the sulphate of ammonia and the whole of the superphosphate may be replaced by 3 cwt. of dissolved bones. If basic slag be used in place of superphosphate, it should be put on broadcast in February. One of the most conspicuous results at Rothamsted consists in the superior action of nitrate of soda as compared with ammonia salts on this crop, but on lighter land sulphate of ammonia would probably act better. This, however, is a matter which each farmer should determine for himself. Salt, no doubt, sometimes acts well on mangolds, but the use of this substance seems unnecessary where kainit is used, as one-third of the latter consists of ordinary salt.

If the crop be grown without dung, the artificials above indicated should be increased by half, and may sometimes even be doubled.

Turnips, Swedes, and **Kohl Rabi,** may, in general, be treated like mangolds, except that they need not get so much dung or nitrogen, but they should receive relatively more phosphates. If 10 or 12 tons of good dung be used the supplementary artificials need not exceed $\frac{1}{2}$ cwt. nitrate of soda and 3 cwt. super. Even this moderate allowance will often fail to pay directly, but the super. will have some influence on the next crop. If the land be very light, kainit up to 3 cwt. per acre may be used, not so much for its effect on the roots as for its influence on the clover that may follow.

In the absence of dung these allowances should be at least doubled ; or, better still, $\frac{1}{2}$ cwt. of sulphate of ammonia may be applied with the seed, and $\frac{1}{2}$ cwt. nitrate of soda may go on a month later as a top-dressing. If the land is very light, fish meal, rape dust, or dissolved bones may partly replace the more soluble substances. If the land is at all disposed to finger and toe it is well not to use either superphosphate or dissolved bones. An equivalent expenditure on basic slag (or bone meal, very finely ground, if the

land is sandy) will, on such land, produce a sounder crop. Precipitated phosphate is also an excellent fertilizer under these circumstances, but it is not always easy to procure. Potash in some form is usually necessary in the absence of dung, and in many cases it is absolutely essential. Four or 5 cwt. of kainit, or a corresponding quantity of sulphate or muriate of potash, will usually suffice. Needless to say, if part or all of the crop is to be folded on the land, the manurial treatment may be less liberal.

Rape, Thousand-headed Kale and **Mustard**, speaking generally, require more nitrogen and less phosphates than the last-mentioned crops, but on fen land the nitrogen need only be used sparingly. As these crops are generally consumed where they grow they need not get farmyard manure.

Cabbages are treated in a variety of ways, but as a rule they should get a liberal dressing of dung, together with 3 or 4 cwt. of superphosphate and as much kainit. When the plants are fairly established, 2—3 cwt. per acre of nitrate of soda, applied in "pinches," or by means of a spoon round the base of each separate plant, should be given. This is a somewhat slow process, but to broadcast nitrate on a crop, where the plants may be two or three feet apart, must be wasteful of manure.

Potatoes, being worth so much more than an equal weight of roots, should be more liberally treated as regards manure. Under ordinary circumstances farmyard manure (15 to 20 tons per acre) should be the basis, supplemented by much the same kind and quantity of artificials as in the case of mangolds, omitting, however, any top-dressing. On the whole, kainit is not the best potassic manure for potatoes, sulphate and muriate of potash often proving superior both as to quantity and quality.

If there is abundance of organic matter in the soil, as, for instance, when potatoes are taken after a two or three years ley, artificials alone will, in many cases, grow a full crop of potatoes.

In view of the valuable nature of the crop, and especially in the case of early potatoes, farmers can not only afford to manure liberally, but it will also pay to compound more complex mixtures than in the case of less valuable crops. The following mixture will be found generally serviceable :—

½ cwt. nitrate of soda.
½ cwt. sulphate of ammonia.
2 cwt. dissolved bones.
2 cwt. super.
1 cwt. sulphate or muriate of potash (about 70 per cent. purity).

It would be an improvement, though involving a little more trouble and expense, to use only ¼ cwt. of nitrate of soda and ¼ cwt. sulphate of ammonia, and to add ½ cwt. of fish guano, and ½ cwt. of Peruvian guano. Five to 8 cwt. per acre of such a mixture may be used with, or double this quantity without, a liberal dose of dung.

The slowness of action and presence of free lime in the case of basic slag render this manure unsuitable for use on potatoes.

Carrots and **Parsnips** are usually grown on light or peaty land, and a good artificial mixture would consist of 1 cwt. of sulphate of ammonia, 4 cwt. of superphosphate, and up to 5 cwt. of kainit. Whether farmyard manure should be directly used will depend on the character of the land and its previous treatment.

For 50 miles round London, and also in other parts of the country, soot at the rate of 5–10 cwt. per acre is largely used, especially on crops that are apt to suffer severely from the attack of insects and slugs, *e.g.*, cabbages, turnips, carrots. Soot supplies nitrogen, of which about 5 cwt. hold as much as 1 cwt. of nitrate of soda, and besides acting as an insecticide and fertilizer it darkens the soil, and from the point of view of temperature this is often an advantage.

Leguminous Crops.

Beans and **Vetches** often receive dung, and although this substance will markedly benefit such crops, it can usually be more advantageously employed otherwise. In an artificial mixture for these and other leguminous crops, nitrogen should be omitted, not because it may be altogether inoperative, but simply because they generally grow sufficiently well without it. Five to 7 cwt. of superphosphate or basic slag, and about 4 cwt. of kainit, or an equal money value of some other potassic manure, will usually prove a serviceable dressing.

Peas should receive no dung, partly because its nitrogen induces the growth of weeds, which are not easily kept down in this crop, and partly because it forces a rank growth of straw and retards the filling and ripening of the pods. The phosphates recommended for beans and vetches may be used on peas, while the potash—peas being generally grown on light land—may be somewhat increased.

Beans, vetches and peas are all lime-loving crops, and for this reason basic slag is well suited to their requirements. On soil poor in lime dressings of lime will produce a good effect, but it is better only to grow these crops on land naturally well supplied with this substance.

Lucerne, Sainfoin and **Pure Clover** do best when they are put in after a well dunged and thoroughly well cleaned root crop, but they should not be directly treated with dung. Phosphates and potash are all-important for these crops. There should, to begin with, be a considerable residue of these substances in the land, the result of dressings applied to the previous crop—usually roots. Such residues are incorporated with the soil in a manner that is difficult, if not impossible, of attainment with direct dressings. As regards immediate applications, some 5 cwt. of basic slag and 2½ cwt. of kainit may be applied in autumn, and as much more kainit, together with 3 or 4 cwt. of superphosphate in spring. When a good stock of the necessary plant-food has been got up in the soil the dressings need not be so liberal.

Hay and Pasture.

Seeds Hay.—Excluding sainfoin, lucerne, and pure clover, hay on tillage land is usually got from pure grass (ryegrass, timothy, cocksfoot, &c.), or from a mixture of grass and clover. The manuring of such crops must depend on the character of the plants and of the land. If clover is absent or very scarce it may be disregarded, and attention be wholly directed to stimulating the grass. In this case nitrogen in some form will be the main fertilizing element. Thus, on an ordinary loam or clay, 1 to 3 or even 4 cwt. of nitrate of soda—applied, in the case of the larger dressings, in two doses—will generally suffice, while on lighter soils sulphate of ammonia may partly replace the nitrate. In the latter case, and on peaty soil, a little superphosphate and kainit (say 2 cwt. of each) may be used. Here as elsewhere, however, the farmer should determine the matter by private experiment.

Where there is a good "take" of clover the nitrogenous dressing must be much curtailed or the clover will be smothered by the luxuriant growth of grass, and the aftermath is likely to be poor. On the other hand, phosphates and potash become of relatively greater importance. With a fair take of clover 1 cwt. nitrate of soda, 2 cwt. superdhosphate, and 2 cwt. of kainit is likely to prove suitable ; while with a strong and abundant clover plant the nitrate may be reduced by half, or even omitted, while the kainit may be nearly doubled, and the phosphates should be increased by the use of about 3 cwt. of basic slag applied early in autumn.

Meadow Hay should, if possible, get about 10—12 tons of dung per acre, applied in autumn, every four years,

artificials being either omitted in these years, or, at most, consisting of about 1 cwt. of nitrate of soda applied in spring. In the intervening years 3 or 4 cwt. of basic slag in autumn, and 1 cwt. of nitrate of soda in spring, will generally pay, though in many cases the slag need only be used every second year. These quantities may be reduced if the aftermath is fed by stock getting cake. Whether potash should be used in the years between the dressings of dung must be determined by each farmer for himself. It would appear, as a rule, to be unnecessary, though this is not always the case.

Where meadows cannot get dung the treatment should be materially different. If the land is found to respond to basic slag it should get a liberal dressing (up to half a ton per acre) in autumn, and for the next two or three years—that is to say, till the clover begins to fail—nothing more need be given. After that time attention should be given to forcing grass, as distinguished from clover, and this may be done by annually using about 1 cwt. nitrate of soda per acre. After two or three years of such treatment, that is to say, five or six years after applying the slag, the land will again be in a position to grow clover, when a liberal dressing of slag (say 5—7 cwt. per acre) should be given, followed in subsequent years by nitrate of soda as before.

If the land is not of the character that responds to slag the treatment should consist of annual dressings of a general mixture of artificials, such as 1 cwt. nitrate of soda, $2\frac{1}{2}$ cwt. superphosphate, and $2\frac{1}{2}$ cwt. of kainit. Needless to say, other sources of nitrogen, phosphates, and potash may also be resorted to.

Pastures should only receive nitrogenous manure if an "early bite" for lambs or cows in spring is of great importance. In other cases phosphates—sometimes with the addition of potash—should alone be used. On land that suits basic slag the treatment may be either about half a ton per acre of this substance every six or eight years, or about a quarter of a ton every three or four years. Which system will pay best can only be determined by trial, but at least it may be said that in the Cockle Park experiments the former has proved much the better. Where a heavy dressing of slag is applied every six or eight years it is an excellent plan to give cake to the stock—especially from the middle of July—from the third or fourth year onwards. In the case of lighter dressings at shorter intervals it may pay well to use cake in the autumn and late summer of every season. If the land is not of a character to grow abundance of clover, moderate dressings of superphosphate or slag (3 or 4 cwt. per acre) possibly with 2 or 3 cwt. of kainit, applied every three or four years, with the use of cake during the latter

part of each season, may be recommended. On very light land fine bone meal sometimes acts fairly well, but here, again, knowledge derived from experiment will prove the best guide.

General Hints on the Use of Manures.

Of hardly less importance than the selection of manures is their distribution. Whatever the amount of manure that may be employed, care should be taken to have it spread equally over the area for which it is intended. One should take pains to secure good mechanical condition, and to do this it may be necessary to pass the stuff through a half-inch riddle, breaking all the lumps that fail to go through. Some manures, *e.g.*, kainit and sulphate of ammonia, go into hard, almost rock-like masses if stored for some months, and when in this condition the expense of pulverising them is no small matter. This is one reason why it is seldom desirable to store manure for a long period. If this has to be done the addition of a small proportion of peat-litter dust or sawdust will make the substance more friable. The necessity of insisting on good mechanical condition is evident from the fact that one often sees artificial manure being sown containing lumps as large as a walnut and sometimes as large as a cricket ball. Not only does the presence of lumps prevent much of the crop getting its fair share of the dressing, but the spots on which the lumps fall are actually poisoned, so that the plants are weakened or killed outright. The loss from the latter cause is greatest in the case of such a crop as clover, and with highly soluble manures like nitrate of soda. Patchy distribution is also very serious where it is specially desirable to produce a uniform crop, as in the case of barley. The danger of loss from washing into the drains or subsoil is also greater where distribution is defective.

Besides lumps, unequal distribution may be brought about by wind, by an unskilful workman, or by an attempt to put on a large dressing by a single "cast." Too often one sees the sower attempting to put on so much that directly his hand clears the edge of the sowing-sheet a considerable amount of manure falls at his feet. The effects of such work may be afterwards traced in brown and withered lines of crop running parallel across the field.

Unequal distribution of another kind is met with where a farmer gives a large dressing to one field, or one part of a field, and a small dressing elsewhere. Needless to say, this is quite a rational proceeding where the land is known to vary markedly in fertility. But sometimes, owing to miscalculation or otherwise, one finds a farmer, for no sufficient reason, giving a liberal allowance of manure to part of his

crop and a small allowance to the rest. Now, it is an incontrovertible principle in manuring that the profits from a small or moderate application per acre of manure are relatively greater than in the case of a large dose. For instance it must pay better—other things being equal—to put 20 cwt. of nitrate of soda on to 20 acres at the rate of 1 cwt. per acre than to apply $1\frac{1}{2}$ cwt. per acre to 10 acres, and $\frac{1}{2}$ cwt. to the other ten. Or the case may be stated thus: If 1 cwt. of nitrate of soda applied to an acre can increase the oat crop by 5 bushels, 2 cwt. per acre will produce less than 10 bushels.

After artificial manure has been applied, it should, if the state of the crop admits of it, be chain-harrowed. If the manure is a soluble one, this operation must be done at once, or much of it may have gone down into the soil, where, of course, it is beyond the reach of further mechanical distribution, but in the case of an insoluble substance, like basic slag, there is not the same need for haste.

Where possible, manure should be thoroughly incorporated with the soil. This is of greatest importance in the case of insoluble manures, and of those, notably dung, which act to a large extent through the improvement that they effect in the physical condition of the soil. Manifestly there may be no choice but to spread the manure on the surface of the ground and to leave it there, but where it is possible to work it in this should be done. For instance, where artificials are being applied to a corn crop at the time of sowing, they should be put in with the seed, so that they may get the benefit of the subsequent harrowing.

Finally, a word of caution may be given as regards the mixing of artificials. Probably it is now universally known that sulphate of ammonia must not be mixed with any manure holding free lime, notably basic slag, and precipitated phosphate. The immediate result of making such a mixture is the liberation of free ammonia, whose presence in the air can at once be detected by its pungent odour. If it is desired to apply sulphate of ammonia with one of these substances to any particular area of ground, the phosphate should be put on a month or more before the other substance. Sulphate of ammonia may, however, be mixed with the other ordinary manures, such as superphosphate, dissolved bones, bone meal, kainit, sulphate and muriate of potash, and nitrate of soda. Nitrate of soda should not be mixed with superphosphate, dissolved bones, or dissolved guano. Not only does such a mixture result in the loss of more or less nitrogen, but the mass is apt to become sticky and difficult to sow. Superphosphate and dissolved bones should not be mixed with basic slag or precipitated phosphate, as this results in the soluble phosphate of the super. or dissolved bones becoming insoluble.

Potash manures (kainit and sulphate and muriate of potash) should not be mixed for more than a few hours with any "dissolved" manure (*e.g.*, superphosphate and dissolved bones) not because anything is lost, but simply because the mass becomes smeary and unsowable.

Generally speaking, the sooner a mixture of manures is sown after it is made the better. Some mixtures, as has been indicated, get smeary, others get lumpy, while others, like basic slag and kainit, may actually become a hard, solid, stone-like mass, which the ordinary appliances of the farmer are insufficient to deal with.

4, Whitehall Place, London, S.W.
February, 1903.

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BOARD OF AGRICULTURE AND FISHERIES.

A Substitute for Dishorning.

It is well known that polled or dishorned cattle can be managed and fattened with greater facility than horned animals, and that, where a consignment consists solely of hornless cattle, the animals can be conveyed by sea or land with less danger of sustaining injury while in transit. The opinion of Irish salesmen and feeders of experience in the cattle trade, who were consulted by the Department of Agriculture and Technical Instruction for Ireland, is to the effect that Irish stores for export, when horned, require more space in railway waggons, on board ships, and in the market-place; that they receive more injury in transit; and that they are worth from 10*s.* to 15*s.* per head less than hornless cattle.

The practice of dishorning cattle, by sawing off or otherwise entirely removing the horns after they are partly or fully grown, appears to inflict great pain upon the animals, and may even be the cause of death; and the Board therefore desire to call the attention of breeders and stock-owners to a method of preventing the growth of the horns by the application of caustic potash to the horn-bud of young calves. If performed in the manner set out below, and with proper regard to the precautions which follow, the operation is comparatively painless, and can be done quickly and with ease:—

Clip the hair from the top of the horn when the calf is from two to five days old. Slightly moisten the end of a stick of caustic potash with water or saliva (or moisten the top of the horn-bud) and rub the tip of each horn firmly with the potash for about a quarter of a minute, or until a slight impression has been made on the centre of the horn. The horns should be treated in this way from two to four times at intervals of five minutes. If, during the interval of five minutes after one or more applications, a little blood appears in the centre of the horn it will then only be necessary to give another very slight rubbing with the potash.

The following directions should be carefully observed :—

The operation is best performed when the calf is under five days old, and should not be attempted after the ninth day.

Caustic potash can be obtained from any chemist in the form of a white stick. When not in use, it should be kept in a stoppered glass bottle in a dry place, as it rapidly deteriorates when exposed to the air.

One man should hold the calf while an assistant uses the caustic.

Roll a piece of tinfoil or brown paper round the end of the stick of caustic potash which is held by the fingers, so as not to injure the hand of the operator.

Do not moisten the stick too much, or the caustic may spread to the skin around the horn and destroy the flesh. For the same reason, keep the calf from getting wet for some days after the operation.

Be careful to rub on the centre of the horn, and not round the side of it.

Note.—Caustic potash is *poisonous*, and must therefore be kept in a safe place.

4, Whitehall Place, London, S.W.,
February, 1903.

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BOARD OF AGRICULTURE AND FISHERIES.

Preparation of Wool for Market.

In view of the great competition in the trade in wool, it is important that flock-masters and others should pay great attention to the conditions under which wool is produced, and to the cleanliness and packing of fleeces before sending them to market. The following suggestions bearing on these points have been drawn up in consultation with the Bradford Chamber of Commerce.

Washing and Shearing of Sheep.

In districts where tub-washing is not adopted, the sheep should be washed without any artificial assistance, that is to say, in cold water without any soap except the natural soap which exudes from the skin in sufficient quantity at the shearing period.

The sheep should not be allowed to run too long after washing before being sheared, as this practically brings the wool back into greasy condition. Nor should they be clipped or the fleeces wound while wet, as this takes away the "liveliness" from the fibre and causes the wool to rot.

The shearing should not be performed in dirty places, such as barns littered with chaff and straw and other matters, which get into the wool and cause much trouble and annoyance. The cost of this fault to the dealer and manufacturer is far more serious than flock-masters think, as it is often impossible to get this foreign matter out without the use of chemicals, which further spoil the wool.

When the fleece is wound, no earth or dung should be left on, or be allowed to get in whilst winding. No locks, tailings, skin wool, black or cots should be wrapped up inside fleeces, neither should greasy wool be wrapped up inside washed fleeces.

Tar-Branding of Sheep.

Where it can be avoided, tar should not be used for marking sheep. A large quantity of wool used for manufacturing purposes does not undergo the process of sorting, and thus it frequently happens that, in spite of efforts to remove tar-marks, some of the tar passes into the finished goods, thereby causing considerable damage and loss. Even when the wool is being sorted it is very difficult to entirely eliminate the tar.

As tar is not dissolved in the ordinary processes of wool-washing, flock-masters should endeavour in cases where its use cannot be avoided to improve the methods of applying it, either by making use of smaller marks or by adopting means to prevent the tar from running. If practicable, marking on the ear or face is much to be preferred.

Methods of Tying Fleeces.

The fleeces should be rolled on a clean wooden table, and should be tied up with bands made by twisting a portion of the fleece itself. It is not necessary for these bands to be tightly twisted, the object being merely to keep one fleece separate from another. String composed of vegetable matter, such as hemp, jute, &c., is bad, and ought not to be used. The most careful manipulation by the manufacturer often fails to detect some small pieces of string, which do not make their appearance until the cloth is dyed, because vegetable matter absolutely refuses to take the dyes used for wool. Dress goods and cloths are often damaged in this way to a very considerable extent. Most farmers tie up their fleeces with wool bands, and have done so for generations, except in a few western and southern counties. In the latter the use of string (and frequently the worst kind of string, such as reaper or binder twine) is not uncommon. This use of string is unprofitable to all the parties concerned. The amount of damage done is a very serious matter to the manufacturer, and the district from which such wool comes suffers in reputation.

Dips.

In the selection of dips, care should be taken to use only those that do not permanently stain the wool, and dipping should not take place for some months before shearing.

The results of experiments arranged by the Departmental Committee, appointed by the Board of Agriculture and Fisheries in April, 1903, to investigate and report upon the dipping and treatment of Sheep, go to show that tar acid (carbolic), tobacco and arsenical, with or without sulphur, dips, when skilfully prepared, leave the wool in a nice condition. Fleeces so treated were placed in the first class by the Bradford Conditioning House, as not having deteriorated in value as a result of the dip. Pitch oil, spirits of tar, and crude tar products lowered the commercial value of the fleece by 5 or 10 per cent.

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BOARD OF AGRICULTURE AND FISHERIES.

Preservation of Eggs.

The supply of eggs upon our markets is very irregular. During the spring and early summer months they are plentiful, both as regards home production and foreign imports. As a consequence prices fall considerably. In the autumn and winter new-laid eggs are scarce and realise high prices, whilst the returns for even the cheaper grades of foreign eggs, most of which are preserved, or "pickled," are considerably above the spring prices. Hence an egg produced in November will command twice, and sometimes thrice, as much as it would in the month of April. If eggs were a non-perishable product, and could be kept in prime condition from one season to another, these variations would be avoided, and the extremes of prices prevented. But an egg under normal conditions soon goes bad. Large quantities of eggs are kept, however, and when the natural deterioration is retarded or stopped they can be sold, if in a good state, at rates which leave a considerable margin of profit, even though they are not equal to "new-laids." Simple means of preservation, too, are extremely useful as a means of regulating the domestic supply. The following are the methods which, up to the present, have yielded the best results :—

Lime Water.

An egg pickle, composed of lime, salt, cream of tartar, and water, was patented upwards of a hundred years ago ; and this preparation, or a modification of it, is still used extensively both at home and abroad. The pickle now generally employed is made by mixing four parts by measure of finely slaked lime with twenty parts of cold water, and afterwards adding one part of salt. This solution should be prepared by mixing the lime and the water a week before it is used, and stirring well together daily, adding the salt on the fourth or fifth day. The eggs should be placed in vats, barrels, or crocks, and the cleared solution poured over them, taking care to avoid adding any of the lime sediment, otherwise there is danger of the solution becoming a solid mass. It is desirable not to fill the vessel with eggs, but to allow two or three inches of solution above the top layer. An excellent arrangement is to add a little fresh solution occasionally, in order to provide for evaporation. An egg preserved by this method can be easily told by the roughness of the shell. When boiled the shell cracks,

a result due to the effect of the lime upon the outer covering, causing it to be hard and brittle. This may generally be prevented by pricking the broad end with a needle when the egg is about to be boiled.

Waterglass.

Waterglass is the name given to a solution of silicate of soda, and is prepared by dissolving the chemical in water. It can be obtained from chemists, and is now largely sold in the form of a concentrated solution, to which should be added five or ten times its bulk of pure boiling water, according to the strength. The preparation should be quite cold before it is used. Experiments in America have shown that a 3 per cent. solution (*i.e.*, 3 parts by measure of waterglass to 97 parts of water) yields as good results as that generally recommended, namely 10 per cent. When the waterglass is added to the water the two must be very carefully and thoroughly mixed. The eggs may be dipped in the waterglass and dried off, leaving a film on the shell, and then stored upon shelves, or they may be kept in the liquid until sold or used. The latter method is to be preferred. When taken out of the solution they are sticky, and before packing should be wiped or dried off.

Cold Storage.

The methods already described are equally suitable for large and small quantities, and may be adopted both by the farmer or by the trader. Cold storage, in order to be profitable, must be operated upon a large scale, and is consequently not available for producers. In America this system is extensively employed, and large plants have been specially erected for the business. Eggs require to be unpacked and laid upon shelves or in trays, and kept at an even temperature, not falling below 33 degrees Fahrenheit, with a free circulation of air, which air should be absolutely sweet. No other products may be kept in the same room, otherwise the eggs will be affected. By this method, provided that the eggs are new laid when placed in storage, they can be kept for many months in good condition, but great care is necessary in removing them for use, as a too sudden change of temperature causes rapid deterioration. In all cases they require to be used very speedily on removal from the cool chamber, and the evidence obtained in this and other countries shows that cold storage eggs will keep for a much shorter period after they are taken out of the chamber, than if preserved either in solutions of lime or of waterglass.

General Suggestions.

Eggs for preservation should be treated as soon as possible after they are laid, but not until they have been cooled. It

is recognised that an egg twenty-four hours old is superior to, and has greater food value than, one a week old. Consequently, if when placed in the preserving medium the egg has depreciated to this extent, the final result cannot be as satisfactory as under the former conditions. It is therefore desirable that preservation should be as near to the point of production as possible.

Eggs should not be treated in a warm place, and where limewater or waterglass is used the preparation should be quite cold before the eggs are placed in the solution.

Eggs from hens fed chiefly upon grain, and with full liberty, are likely to keep better than those laid by fowls in confined runs.

The general experience has been that infertile eggs keep in good condition longer than those which contain a living germ. Probably this is less apparent when eggs are preserved at a low temperature.

When eggs are preserved in waterglass or limewater the containing vessels should be stored in a cool place, at a temperature of not less than 33 degrees Fahrenheit, nor more than 45 degrees. A cool, well-ventilated cellar is excellent for this purpose. Exposure to a higher temperature, even for a few hours, will cause deterioration in spite of the preservative.

Eggs may be stored in large or small quantities. They may be allowed to remain in the pickle until the following season, if desired. Iron vessels should not be used.

Preserved eggs should be carefully tested by light before they are sold. For this purpose a well-constructed candling lamp is to be preferred; but a piece of black cardboard, 8 inches square, with an oval hole in the centre rather smaller than an ordinary egg, can be used. Each egg is placed against the hole, and held between a strong light and the eye, so that the condition of the contents can be observed. All dark eggs or those showing spots or black shadows should be rejected.

The best months for preserving are March, April, May, and June. It has been found in many cases that summer eggs do not keep nearly so well as those laid before the hot days.

Preserved eggs should be sold under that name, and not as "new-laids," "breakfast," or "fresh" eggs.

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BOARD OF AGRICULTURE AND FISHERIES.

The House-Sparrow.

The house-sparrow (*Passer domesticus*, L.) is so well known that a detailed description of it is unnecessary. In almost all parts of Europe where grain is grown it is, unfortunately, far too common. In New Zealand, Australia, and North America it has been introduced, and has increased there, as here, to such an extent as to become a serious pest to the farmer and gardener alike.

To practical farmers the case for the reduction of the sparrow to smaller numbers rests upon an estimate of the damage done, compared with the useful work carried on by the bird. It may be taken for granted that no one wishes to exterminate the sparrow altogether, but it is the opinion of all who have paid any attention to the subject, that the limits of the sparrow's usefulness have long ago been overstepped, and that its reduction to more reasonable numbers is as necessary in the interests of the community at large as the reduction in the number of rats, or of any other destructive beasts, birds, or insects.

Hundreds of examinations of the contents of the stomachs of sparrows have been made in this country and abroad, and it has been shown that from 75 to 80 per cent. of the food of adult birds throughout the whole year consists of cultivated grain of some sort. A farmer in the neighbourhood of a town or village where the bird has been unmolested has this fact forcibly brought home to him in much diminished crops. In such districts, the profitable cultivation of cereals becomes well-nigh impossible.

The sparrow does most damage during the few weeks before harvest. Thousands of adult birds and young of the season feed upon the ripening grain and live almost entirely in the fields, deserting the village and farm homesteads for a time. Later they live mainly round human habitations taking grain from the stacks and poultry yards.

The destructive practices of sparrows are not confined to grain crops. They are almost equally damaging to garden produce, apparently taking a delight in stripping gooseberry and red currant bushes of their buds, tearing in pieces various brightly coloured flowers, such as crocuses, primroses, and violets, eating the young shoots of carnations in winter, and pulling up rows of newly-sown peas in spring and summer.

Ricks and thatch are damaged by them, and rain-water pipes are frequently blocked by their nests.

It may reasonably be asked if nothing can be said in favour of the sparrow. Examination of young birds in the nest, and those recently fledged, has shown that they feed partially upon caterpillars, beetles, and other insects. The amount of their food consisting of insects is, however, not more than 50 or 60 per cent., and then only for a short period of their early life. The extent of their usefulness in this respect is thus not sufficient justification for maintaining the vast numbers which are met with throughout the country. It must also be remembered that the sparrow drives away swallows, house-martins, many warblers, and other purely insect-feeding birds, which would do most of the useful work carried on by the sparrow if they were undisturbed.

It may perhaps be advisable to note that the hedge-sparrow (*Accentor modularis*, L.) is in no way related to the house-sparrow, the former being a very useful bird, which needs protection, since its diet consists almost entirely of insects. It has a soft narrow beak quite unlike that of the house-sparrow, which is hard and specially adapted for eating seeds.

The only bird likely to be mistaken for the house-sparrow is its near relative the tree-sparrow (*Passer montanus*, L.). The latter is a much rarer and more locally distributed species, somewhat smaller in size, with two white bars across its wings instead of one as in the house-sparrow. The male house-sparrow has a white patch on its cheek or side of its head; in the tree-sparrow the white cheek has a black triangular patch on it. The tree sparrow is of small economic importance compared with the other.

The nest of the house-sparrow is placed in all sorts of situations: exposed in trees and shrubs, in holes in hayricks, thatch, walls and trees, in rain-water pipes, under the eaves of houses, in ivy-clad walls, and in the nests of the house martin and swallow. It is rarely found more than a mile or so from human dwellings, and is usually made of straw, hay, or dried grasses, more or less in the form of an oval ball with an opening into it at the side. Five or six eggs are laid, of a bluish-white ground colour, variously blotched or speckled with brownish or blackish markings. The nest of the hedge-sparrow, on the other hand, is open, and composed of plants, roots, and moss, lined with hair or wool, while the eggs are blue in colour.

Each pair of birds may rear two or three broods during the summer, which accounts for the rapidity of increase when unmolested in districts where food is plentiful.

Any attempt to reduce this, or any other living pest capable of rapid reproduction, must be thorough and must embrace the whole of the district infested. It is of little use to kill the sparrows in one locality, if they are allowed to multiply in surrounding parishes. Not only should sparrows

be destroyed round villages and hamlets, but attention to every isolated farmyard in the neighbourhood is essential. Sparrows left to multiply on one or two farms in a district soon spread over the neighbouring areas.

The particular methods for lessening the number of sparrows are very numerous. Eggs and nests may be destroyed in the breeding season. Various forms of nets may be employed on dark nights, around ricks or ivy-clad houses where the birds roost. Shooting with small shot during winter is useful. In all cases great care must be exercised to prevent other birds suffering along with sparrows.

As individual private effort can have but a slight effect, the work of lessening the sparrow plague in a district is best carried out by the formation of a Sparrow Club.

The object to be attained should be made clearly known to all who join it. Anything like indiscriminate destruction of small birds in general should be strenuously avoided, the object being merely to reduce the numbers of the house-sparrow. Every encouragement should be given to the protection of all other small birds, unless there are obvious reasons for including other species than the sparrow in the black list.

Very frequently it is found that rats can be dealt with at the same time as sparrows.

The following may be taken as a scheme of rules, which can be amended or curtailed according to the requirements of the district :—

Rule 1. The name of the club shall be "The............and District Sparrow [and Rat] Club," and includes the parishes of.......................

Rule 2. The club shall consist of subscribers or honorary members and working members. The annual subscription of an honorary member shall be not less than 5*s.* [or 2*s.* 6*d.*], that of a working member 1*s.* Honorary members shall be exempt from bringing heads.

Rule 3. House-sparrows and rats only to be decreased. Each sparrow shall count one point, each rat two points.

Rule 4. Each working member shall send in during the year birds or rats representing not less than 300 points before he is entitled to share in the division of the prize funds.

Rule 5. No birds or rats shall count unless they are taken n the parishes mentioned in Rule 1. Any member infringing this rule shall be fined 5*s.*

Rule 6. Members found smoking in stackyards or on any premises whilst catching sparrows or rats, or loading shot-guns with ordinary paper instead of stout wads, shall be disqualified for all prizes.

Rule 7. The balance at the end of the season shall be divided among the working members according to the total number of points obtained during the year.

Rule 8. Collectors shall be appointed in various parts of

knocked out of the hay the loss of nutritive substances is quite out of proportion to the loss of weight.

If the ley be a new one, and the grass chiefly consists of a single species, say ryegrass, the time to cut is not difficult to determine. But on old grass-land, carrying a great variety of plants, some species may be dead ripe before others have come into flower. Meadow Foxtail, Sweet Scented Vernal, Cocksfoot, and the Rough and Smooth stalked Meadow Grasses may be ripe, and have shed much of their seed, before such a grass as Timothy has come into flower. It is therefore impossible to catch all plants exactly at the right time, but at least a farmer should start his hay harvest on a field where early grasses are most abundant, or where, owing to thin soil or a south exposure, maturity is most advanced. Then, again, there are some plants, like Cocksfoot, which become hard and unpalatable sooner than others, and, where these predominate, cutting may take place before the flower heads are well out of the sheath.

A little loss in weight owing to making an early start is usually more than counterbalanced by the superior feeding properties of the crop, and by the greater quantity and quality of the aftermath. If a second crop of hay is contemplated, the advantages of starting early with the cutting of the first crop are specially emphasised.

Manner of Cutting.

In the case of meadow hay the crop can hardly be cut too close to the ground, but with rotation hay it is found that red clover produces more aftermath if the first crop has not been cut too close, and, especially so, if very sunny weather occurs when the crown of the root has recently been exposed. It is contended that red clover is most permanent, and the aftermath is better, when the crop is cut by the scythe than where the mowing machine is employed. This result has been ascribed to the cut surface made by the scythe being somewhat oblique and so running off the rain, whereas the cut of the machine is perfectly horizontal allowing the rain to enter and to rot the root, but it is probable that the greater length of the stubble generally left by the scythe is the true cause.

"Making" the Hay.

It hardly need be pointed out that the weather is here the determining factor, but as a general principle it may be said

that the less hay is turned and knocked about the better. Every time it is moved it suffers loss through the shedding of seed, and the separation of the fine leaves, and especially clover leaves. These two portions, the seed and fine leaves, are the most valuable part of the crop, and every effort should be made to preserve them. Then, again, the more hay is moved the more are the stems and leaves of the plants bruised and broken, and should rain subsequently intervene a relatively large amount of nutritive matter will be washed out of the crop.

Every farmer strives to get his hay beyond the washing influence of rain as soon as possible. Rain water may dissolve and remove more than ten per cent. of the dry matter of hay, and what is thus removed may represent quite twenty per cent. of the feeding value.

In the drier districts of England hay is generally raked into windrows straight from the swathe, and put directly into the stack, but in other districts it has to be turned, cocked, and often piked, or put into field "tramp-ricks" before being fit to stack. If the weather admits of the crop being stacked or ricked straight from the swathe the minimum of loss will occur, combined with greatest economy of labour; but if this cannot be done, and if wet weather threatens, it is a great advantage to put the crop, even if not in first rate condition, into small cocks, which, when the weather is dry, may be shaken up, and afterwards carted. Half an inch of rain means some 50 tons of water per acre, and if the crop be equally spread over the ground it is, of course, subjected to the whole of the washing influence of this quantity of water. But if the crop be put into cocks that occupy only one-tenth of the area it follows that the hay will be affected by only one-tenth of the rainfall, that is to say by 5 instead of 50 tons of water.

Not only does water actually wash out much of the soluble and most valuable of the constituents of hay, but it also removes the aroma, and leaves the crop much less appetising as food for stock. The colour, too, suffers, and with it the selling value.

In the stack the hay should be consolidated as thoroughly as possible, and this is secured by spreading it evenly, and by careful trampling. The object is to exclude air as much as possible, and so to keep fermentation within proper bounds. If this is secured, the produce will be of a good colour; green, in the north and west, where the natural sap is largely eliminated by handling in the field, and brown, in the south, where the sap is more conserved. If the crop is loosely stacked, air enters too freely, excessive fermentation takes place, and the resulting produce, being partially carbonised, will be very dark in colour and of low value. A light crop, or a crop consisting of fine grasses, packs more

easily in the stack, and requires less trampling, than a strong "stemmy" crop into which air enters more freely.

For details of haymaking on a large scale, by the use of labour-saving machinery, reference may be made to an article by Mr. Primrose McConnell in the first number of Vol. IX of the Board's Journal.

4, Whitehall Place, London, S.W.,
May, 1903.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Brown Rot of Fruit.

(*Sclerotinia fructigena.*)

This is undoubtedly one of the most general, and also the most destructive of diseases against which the fruit grower has to contend. It attacks apples, pears, plums, cherries, peaches, and is also not uncommon on various wild fruits belonging to the order *Rosaceæ*, as bullace, crab, &c.

To the ordinary observer this disease first attracts attention when it appears on the fruit under the form of brownish scattered patches on the skin. This is followed by the growth of dull grey tufts (the so-called *Monilia* fungus), which are usually arranged in irregular concentric rings. These grey tufts are composed of dense masses of spores arranged in long branched chains.

The fairy-ring arrangement of the fungus is most evident on apples and pears; on plums, cherries, and stone fruit generally, the grey tufts are irregularly scattered over the surface.

Although most obvious on the fruit, the fungus usually first attacks the leaves, where it forms thin, velvety, olive-green patches. The spores from diseased leaves are washed by rain, or carried by insects, on to the surface of the young fruit, or not infrequently the flowers are also inoculated from spores derived from young leaves; and in many instances where brown and shrivelled blossoms are attributed to the action of a late frost, the true cause is in reality due to the *Monilia* fungus.

In those instances where the disease has been allowed to follow its course undisturbed for some years, the young shoots of the trees are also attacked and killed during the first or second year. The fungus develops rapidly on such dead twigs, and furnishes a ready supply of spores, which are mature during April and May, just when the young leaves and blossom are most susceptible, and wholesale infection results.

Fruit attacked by this disease does not rot and decay, but becomes dry and mummified. Such fruit often remains hanging on the tree until the following season. Whether it does so or falls to the ground, it is practically unchanged until the following spring, when its entire surface becomes covered with a copious crop of spores, which are dispersed by various agencies, and the disease repeats itself.

It has long been suspected that the *Monilia* represented but one stage in the life-cycle of the fungus; this supposition has proved to be correct, the second or ascigerous form of fruit having been found growing abundantly on old half-buried peaches in several orchards in different parts of the United States, where the fungus proves quite as destructive as with us.

Preventive Measures.

All dead twigs and shrivelled fruit, whether hanging on the tree or lying on the ground, should be collected and burned during the winter.

After the diseased fruit and dead branches have been removed, the trees and also the ground should be thoroughly drenched with a solution of sulphate of iron, prepared as follows:—

Sulphate of iron...	25 pounds.
Sulphuric acid	1 pint.
Water	50 gallons.

Pour the sulphuric acid upon the sulphate of iron, then add the 50 gallons of water by degrees. A barrel is the best vessel to use; a metal vessel must not be used, as it would be acted upon by the sulphuric acid.

Spraying with the above solution should be done in January or February, before the leaf-buds begin to swell in the least, otherwise the foliage and blossom will be destroyed.

When the leaf-buds are expanding, and at intervals as required, the trees should be sprayed with quite weak Bordeaux mixture.

The above line of treatment must be followed for at least two seasons.

Explanation of the Figures.

1. A diseased shoot with the persistent blossom of the previous year; cut from the tree in February. Both twig and flower-stalks bear tufts of the fungus. Nat. size.

[TURN OVER.]

young fruit trees takes place, the spores gaining access to the stem either through the unprotected ends of pruned twigs or through the living bark itself.

All wounds on the stem exposed by cutting off shoots, *however small*, should be protected *at once* by a coating of gas-tar, until the tree is at least ten years old. If this precaution is neglected, spores frequently alight on the newly-formed wounds, where they quickly germinate and spread upward and downward in the living bark, which becomes discoloured; finally the fungus bursts through the bark it has killed, and produces spores on the surface (Fig. 6).

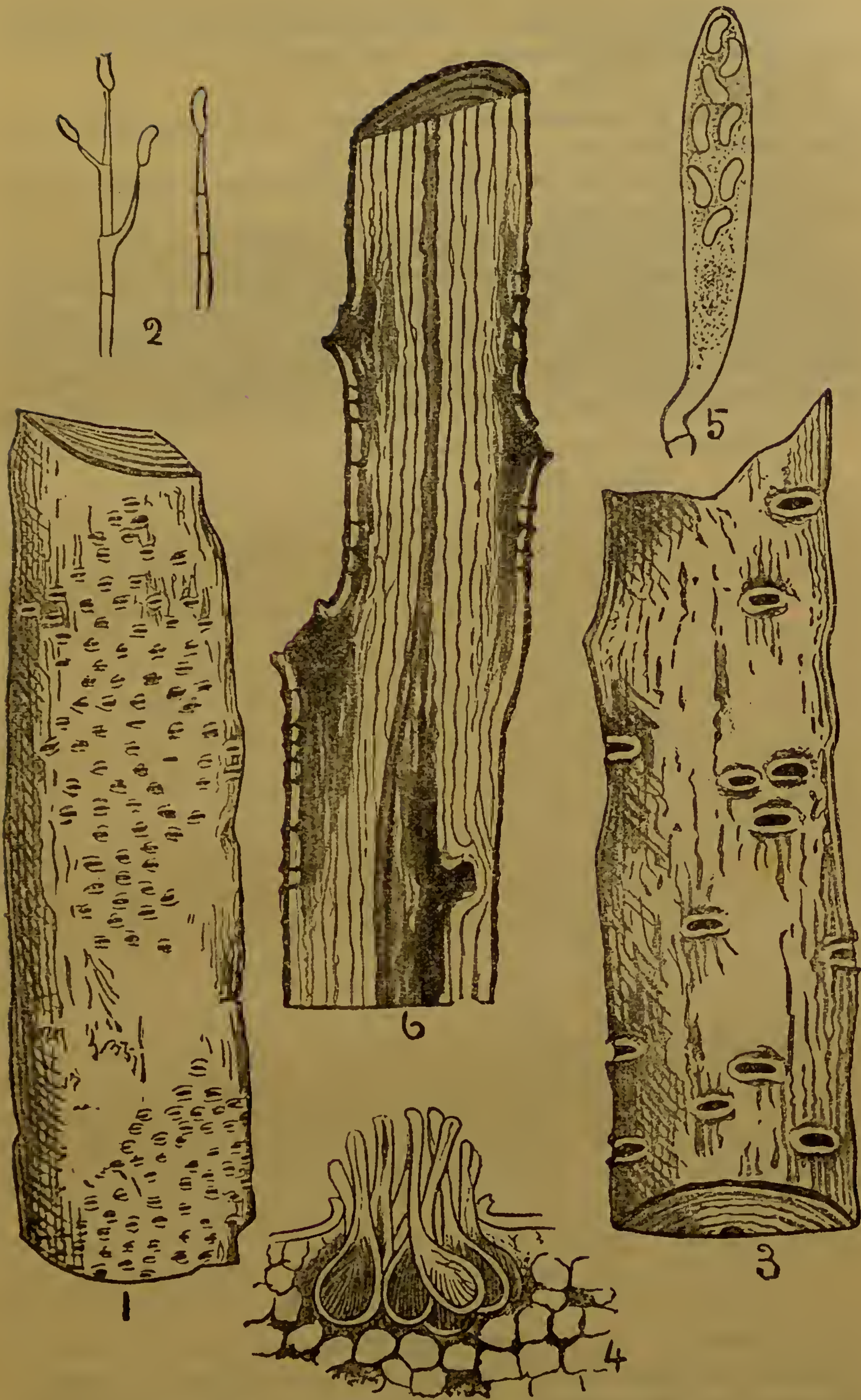
In order to prevent spores from germinating on the surface of the stem, and then entering through the bark directly, the entire stem of the tree should be painted with the following composition:—Reduce soft-soap to the consistency of thick paint by the addition of a strong solution of washing soda in water. Add one pound of powdered quick-lime to every five gallons of the dissolved soap, and stir the whole until thoroughly mixed. Apply to the trunk with a paint brush, being careful to cover every part. This mixture is tenacious, not easily dissolved by rain, and usually lasts for one season if properly made and applied.

Up to the present the disease has only been observed on a large scale where the trees are growing in stiff clay. Under such conditions it is very important to avoid deep planting, otherwise the roots are liable to be killed, owing to the presence of stagnant water, lack of air, &c., during a continuous rainy period, especially in spring or early summer. If the trees are not actually killed by this means alone, which is very frequently the case, their vitality is considerably weakened, and they are thus rendered more susceptible to the attacks of parasitic fungi.

In a case of an extensive attack which the Board investigated in the county of Nottingham in 1902, the trees had evidently been seriously crippled by being planted too deep in a strong soil, and were consequently specially susceptible to attack.

It is important that the fungus should be recognised by gardeners, as its frequent occurrence on wild trees in hedgerows might lead to the infection of nursery stock in a wholesale manner, as has in fact taken place, more than once, unless detected and removed without delay.

All diseased plants should be burned at once, as, if allowed to lie about, the spores mature on the dead wood, and are scattered by wind, a risk of further infection being thereby incurred.



[*Turn over.*]

Description of Figures.

1. *Eutypella prunastri;* spore-bearing form of reproduction on an apple tree stem. Nat. size.
2. Spores. × 600.
3. Second, or ascigerous, condition of fungus-fruit on plum stem. Nat. size.
4. Section through a group of ascigerous fungus-fruits embedded in the bark. × 50.
5. Ascus containing 8 ascospores. × 400.
6. Median section through portion of the stem of a young apple tree, showing where the fungus had entered through the unprotected ends of pruned shoots. The mycelium of the fungus had discoloured the bark and wood, and finally burst through the bark to the surface. Nat. size.

4, Whitehall Place, London, S.W.
May, 1903.

BOARD OF AGRICULTURE AND FISHERIES.

Hop Aphis.

The chief insect pest with which the hop grower has to contend is the Hop Aphis (*Phorodon humuli*), also known as the Hop "Fly" or "Louse." In former years, before the introduction of washing to combat this pest, the hop crop was often almost entirely destroyed by its attacks; and hops would rise to famine prices, since so few could be picked from the gardens which partially recovered from the invasion or had escaped it wholly. The last general "black blight" occurred in 1882, since which year washing has been universal among the good growers of hops, but even the past three years have seen attacks which have seriously affected the crop either in quality or in yield. Early in June the first symptoms of an attack are usually to be seen; here and there among the hops will be found a stout winged green aphis, and on the underside of the unfolding leaves near the tops of the shoots minute wingless "lice" may be detected, the soft growing points of the plant being always the parts first attacked. If the weather conditions are favourable and nothing is done the aphis multiplies with inconceivable rapidity; in a week or two the undersides of all the leaves become dotted over with wingless lice of all sizes, while the sticky exudations from the insects coat the leaves below and give them a dark shiny appearance. Finally, this "honeydew" turns black, the growing shoots shrivel and curl, and the development of the whole plant ceases. Sometimes after such a "black blight" the plant clears itself later in the season, and should heavy rain wash the leaves, it will put forth a little new growth on which a few hops will be carried. Should the conditions be less favourable for the rapid multiplication of the aphis, lice may be found on the plant during the whole season, and will then harbour in the cones of the hops; as they die there the remains turn black owing to the invasion of a fungus, and the hops, after picking and drying, will be found with black cores, by which their value is much deteriorated.

Description and Life History.

The hop aphis belongs to the large family of plant lice, which includes many of the most characteristic pests of the farm and garden, such as the well known "green fly" of the

rose, the black "collier" which infests the top of broad beans, the black cherry louse, the reddish lice of apples, plums, and currants, the aphis of corn, and of the turnip, &c.

The mature form of the hop aphis is about one-eighth of an inch long, with a plump body and three pairs of legs, the mouth is prolonged into a proboscis adapted for piercing the leaves of the plant and sucking the sap upon which the insects live; towards the extremity of the abdomen are two tubes from which exudes the sticky "honeydew." Two pairs of transparent wings may or may not be present, for both winged and wingless female forms occur, the former being generally distinguished as "fly" from the wingless "lice"; there is also a winged male.

Two cycles of life history are known, one complete on the hop, the other involving a migration from the sloe, damson or plum back to the hop again. This latter cycle is the most important.

In the first cycle the wingless female form hibernates in the ground and crawls on to the hop plant in the spring, when she immediately begins to deposit living young upon the soft leaves. These young in their turn begin to reproduce themselves without the intervention of a male for many generations, multiplying with astonishing rapidity. Some of these lice enter the pupal state, from which they emerge as winged females and fly to other hop plants, where they again reproduce themselves asexually. Finally, towards the autumn most of the lice turn into pupae, and emerge as winged females and males, which copulate before leaving the hop. Some of the wingless females go to ground before winter and hibernate until they can resume their asexual reproduction on the young hop in the spring.

In the second cycle the winged female after fertilisation by the male in autumn leaves the hop and flies to the sloes, damsons or plums, where she deposits eggs near the tips of the shoots and in the forks of the twigs. In the spring these eggs hatch into lice, which in May or early June develop wings; the winged females then fly back to the hop, where they reproduce living lice as before described for ten or twelve generations before fresh winged forms are developed. It is the enormous rapidity with which the wingless forms reproduce themselves that constitutes the danger of an attack of the hop aphis; the whole plant may become completely smothered in lice if neglected for a week or two.

Natural Enemies.

The lady-birds, both in their adult and larval forms (when they are known in the hop gardens as "niggers") are great devourers of aphis and are sometimes numerous enough to keep a mild attack in check.

The lace-wing fly, which lays its white eggs in little groups, each supported on a long stalk, on the underside of the leaves of the hop and other plants, devours great numbers of aphides when in the larval stage.

Several species of chalcid fly are parasitic upon aphis; they lay their eggs in the living aphis, the interior of which is devoured by the larvae.

Treatment.

The only way of dealing with the hop aphis is to spray or "wash" the hops with a mixture containing soft soap as a basis. As the aphis secretes something of a sticky or waxy nature it is not readily wetted by pure water; the presence of the soft soap causes the wash to touch the aphis, and as it dries the thin layer of soft soap clogs the breathing pores and kills the insect. A few growers use soft soap alone, the majority add a decoction of quassia chips, the bitter principle of which is either directly poisonous to the aphis or renders the leaves distasteful to those which escape. Paraffin, reduced to a fine emulsion in the soft soap mixture, is also employed; though extremely effective, killing the aphis at once, it requires to be used with great care. However carefully the emulsion is prepared the paraffin has a tendency to separate and collect in sensible drops, which scorch any foliage on which they fall. Mr. Cousins, late of the Wye College, overcame this difficulty by dissolving naphthalene in the paraffin, thus rendering it heavier and diminishing the tendency to separate. There are also other patented preparations, but the majority of growers still use quassia and soft soap.

The soft soap should be carefully selected, it should be newly made and from such kinds of oil as do not yield hard flocks of curd when the soap is mixed with hard water. It is desirable to test beforehand the lathering powers and the character of the curd that is formed by dissolving one-fifth of an ounce of the soap in question in half-a-gallon of water, shaking well and observing the stability of the lather and whether any curd separates on standing. The amount of soap to be employed varies with the hardness of the water; with soft water four pounds per 100 gallons will be sufficient, while hard waters often require eight or ten. Large quantities of soft soap will scorch tender foliage, hence when the water is hard it is advisable to have an analysis made, as it is often possible to reduce the hardness by adding a little carbonate of soda.

6lbs. of good quassia chips are simmered for two hours with just enough water to keep the mass liquid, the decoction is strained off and the soft soap is stirred in till it dissolves, a process which may be assisted by further boiling. This

stock mixture is diluted down as required with cold water to 100 gallons. Many forms of spraying machines are used for distributing the wash. For small gardens a hand machine with two nozzles on flexible tubes may be used, but large acreages require the use of horse machines holding about 80 gallons of wash; the double or treble acting pump being driven from the wheels of the machine as it moves along. For an account of competitive trials of various machines the Journal of the Royal Agricultural Society for 1899, page 548, may be consulted. The spray should be fine, but not so fine as to become practically a mist, the object being to drive the wash with sufficient force to thoroughly wet every leaf of the growing plant. The amount of wash required will vary with the machine and the state of the bine: for a fully-grown garden 200–400 gallons per acre will be needed.

Washing should begin as soon as lice are detected on the young leaves; as it is almost impossible to clean the garden if once the aphis is allowed to get a start. In bad seasons washing may have to be repeated again and again, practically continuously throughout June and July and early August. Every effort should be made to get the plant clean before the hops begin to form, as it is impossible to reach the aphis if once it gets a lodgment inside the cones of the hop. For this reason a late attack of aphis is the most dreaded by the hop grower, because he is then powerless to stamp it out, though washing right up to the time of picking will keep down the numbers which enter the hop. The lower leaves and laterals, and suckers about the base of the plant, should be stripped away, as they harbour lice and are difficult to wash.

The cost of washing on a large scale amounts to about 20*s.* per acre for both materials and labour, but much depends on the proximity of the water supply.

As the hop aphis in the main migrates from the damson and plum to the hop, the use of the caustic wash, described in Leaflet No. 70, on the fruit plantations in the winter will tend to diminish the attack on the hops in the following summer by destroying the eggs of the aphis.

4, Whitehall Place, London, S.W.,
June, 1903.

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BOARD OF AGRICULTURE AND FISHERIES.

Fluke, or Liver Rot in Sheep.

Fig. *a*. Adult Liver Fluke. *b*. Water Snail (*Limnaea truncatula*). Nat. size.

The disease known as Rot, Liver Fluke, Coathe, and Bane, in sheep, has existed in Great Britain for very many years, and has caused greater losses in this country than any other disease affecting this particular class of animal. The last severe outbreak occurred in 1879 and continued into the year 1880; and in the statistics prepared by the Board of Trade for 1881 there was a falling off in the number of sheep in Great Britain of no less than three and a half millions compared with that given for 1879. This decrease was reported to be mainly due to the prevalence of rot, the greatest losses having occurred in England, and Scotland being but little affected.

Life History of the Liver Fluke.

The common liver fluke (*Fasciola hepatica*) is found in the biliary passages of the livers of sheep, where it produces many thousands of eggs, which find their way along the bile duct into the intestines and are expelled with the dung. Those which fall upon dry soil may remain dormant for months, but how long they may retain their vitality is not known; whilst those which reach the water in pools and dykes are at once hatched, and a free swimming *ciliated embryo* is produced. This little organism is provided with a small boring prominence, and as it swims about in the water it searches for a certain species of water snail, to the surface of which it fastens itself, and eventually bores its way into its body. It then becomes the *sporocyst*. The sporocyst grows slowly within the snail, and eventually the germ cells which it

contains produce other organisms called *rediæ*, 5 to 8 in number, which eventually escape from the sporocyst and attach themselves to the liver of the snail. Within each redia are formed from 12 to 20 individuals of the next generation, which are known as *cercariae*. These last-named organisms are somewhat similar to the adult parasites into which they eventually develop, their bodies being flat and oval in shape, but they are provided with a tail. After leaving the redia these cercariae pass out of the body of the snail into the water, where they swim about until they attach themselves to a blade of grass or some other object; subsequently they lose their tail, become encysted—that is, form a case—and remain quiescent until swallowed by the sheep, in whose stomach the wall of the cyst is destroyed. The liberated parasite ultimately finds its way to the liver of the sheep or other animal, and develops into the adult hermaphrodite fluke.

The fluke parasite runs through three reproductive generations, namely :—

1st. The sporocyst ;
2nd. The redia ;
3rd. The adult fluke.

There is a gradual increase in the number of the organisms derived from each of these generations. For example, the sporocyst containing germ cells gives rise to several (5 to 8) rediæ, and each redia to a larger number of cercariae (12 to 20), while it has been calculated that each adult fluke may produce the enormous number of 45,000 eggs. But for this remarkable fertility there would be comparatively small chance of the entire cycle of life of the fluke parasite being completed.

Symptoms of Rot in Sheep.

In consequence of the extremely slow development of this disease, the fact that the sheep are affected is scarcely ever realized until a long time after they have become infected. The symptoms of the disease progress slowly and are characterised by a very gradual sequence of changes, which vary in accordance with the different stages of the disease, and with the health of the animal. In the primary stage, when the flukes are first developed in the bile ducts of the sheep, their presence causes such an amount of irritation to the liver as is sufficient to produce an increased secretion of bile, which in itself has a tendency to aid the digestive process, and as a consequence the animal may feed well and for a time put on flesh. Soon after, as the number of the flukes increases, the liver begins to enlarge, and the bile becomes slightly tinged with blood. At this period the animals fall off in condition and display pallor of the eyes and the gums. The appetite, which was formerly very good, now becomes capricious, and the animal loses strength. As the disease advances the sheep becomes

extremely emaciated and weak, dropsical swellings are to be found under the jaws, and the abdomen becomes greatly enlarged ; while the respiration is short, and the liver will be found to have increased in size and to have become very hard. If a post-mortem examination be made at this stage the bile ducts within the liver will be seen to be thickened, and their walls when dissected will frequently be found to be calcareous. The bile has a dirty brown colour and abounds with mature and immature flukes and multitudes of ova. When the disease appears among a flock of ewes it is a very common thing for many to abort, and the mortality in a flock may be very high.

Should the sheep survive this stage, which is quite unusual, a period of convalescence sets in of a slow and generally of an unsatisfactory nature. During its progress the flukes are said to leave the liver and pass out in the droppings, but the pathological changes which their long presence has caused within the liver produce emaciation and debility in the animal. The period of time during which these various changes are in progress may be roughly stated as twelve or more months, *i.e.*, from the time of invasion to the time of disappearance of the flukes.

Distribution of the Fluke.

As a general rule rot is confined to the lowlands, marshy valleys, &c., but it may occur in the high lands. It is also more frequent in wet than in dry seasons, and is most prevalent after prolonged rains in the late summer and autumn. It is often associated with the presence of "carnation grass" and similar sedges, and many farmers look with suspicion on land that carries these plants.

From the preceding sketch of the life history of the fluke it will be evident that the conditions necessary for the propagation of the disease in any district are :—

1st. The presence of fluke eggs.

2nd. Wet marshy ground or pools suitable for the hatching of the ova.

3rd. The special snail (*Limnaea truncatula*) to act as intermediate host.

4th. The presence of sheep or other animals to swallow the encysted parasite and thus become infected.

Preventive and Remedial Measures.

Sheep ought not to be purchased from a flock reared on fluky ground.

Those sheep which are affected with fluke should be sent to the butcher at once while in a marketable condition, and the others moved on to dry ground.

The livers of the slaughtered sheep should be destroyed, or, if used for dogs' food, they should first be well boiled, as otherwise the fresh eggs may pass uninjured through the intestines of the dog and thus infect the soil.

If rabbits and hares are plentiful on infected ground, they should be kept down, as there is an idea that they may spread the disease; there is no proof however that they do so.

If infected animals have been pastured on a given piece of ground, it would be advisable to have the droppings spread by chain harrowing, so as to assist in drying them, and thus hasten the destruction of the eggs; a little lime would assist this.

Drain if possible.

When practicable, dressing the ground in late summer and autumn with salt alone, or with a mixture of salt and lime, will usually be attended with good results. Sheep should also have access to lumps of rock salt, and where sheep are getting cake, corn, chaff, &c., a little salt ($\frac{1}{4}$ oz. per head per day) mixed with such food should always be provided where fluke is to be feared.

If practicable, it is desirable to place the animals on higher and drier ground.

Give a daily allowance of dry nutritious food, with each 120 lbs. of which may be incorporated 4 lbs. salt, and 1 lb. sulphate of iron.

Do not overstock the pasture or eat it too bare.

Do not leave the sheep long on the same land.

A most important thing is to cart away at once, or cover up with gas lime, the mud, reeds, etc., taken from ditches, pools and ponds when being cleaned out. Numbers of the snails and their eggs, and often the parasites within them, are destroyed when gas lime is put over this rubbish.

Finally :—Whenever rot is suspected in a flock of sheep, sharp observation over the animals will often enable the owner to detect the disease before it has made any serious interference with the health of the majority; and if on a post-mortem examination of the first suspected cases flukes are found in the bile ducts of the liver, it becomes an important question to the owner whether it would not be to his interest to slaughter the whole of them at once, while they are in a marketable condition, rather than allow the disease to continue, since by leaving the animals alive they will probably be the means of permanently infecting his pastures.

4, Whitehall Place, London, S.W.
July, 1903.

Revised March, 1904.

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BOARD OF AGRICULTURE AND FISHERIES.

The Pith Moth.—(*Laverna atra*, Haw.)

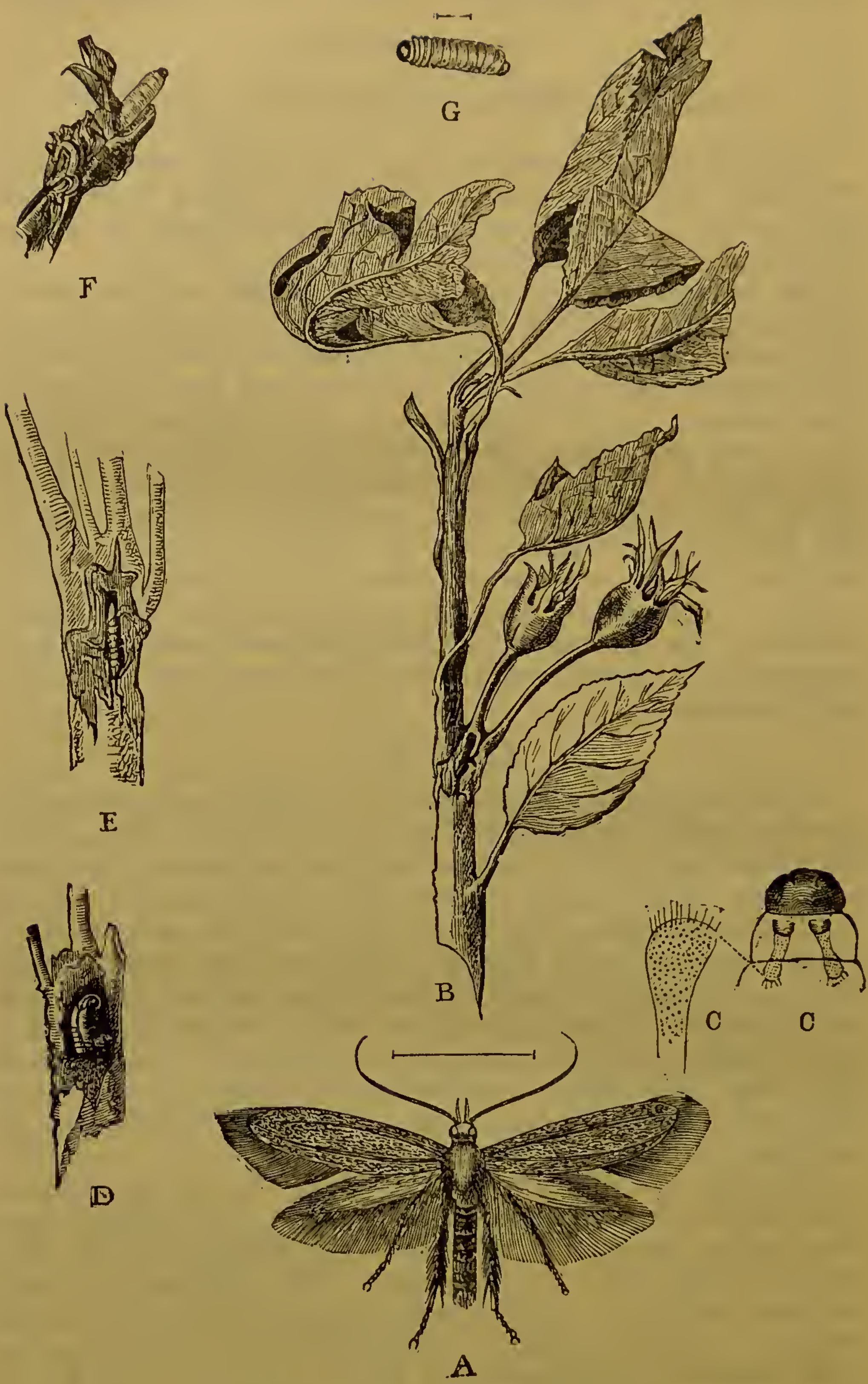
Much damage is caused to fruit trees by the larvæ of the Pith Moth, but as the moth is not often seen, it is probable that few people are acquainted with it; although it occurs over a large area of England.

The damage done by the larvæ is particularly noticeable in nursery stock. They burrow up the terminal shoots and kill them, the result being deformed and stumpy trees. The attacked shoots flag and then die and turn brown, the dead masses varying from two to four inches in length, These dead shoots may remain for some time on the tree, or they may fall to the ground naturally, or be beaten off by heavy rain. The attack may readily be told from that of the Red Bud Caterpillar by the absence of leaves spun together, and the absence of damaged buds and blossom; but the whole shoot dies away. Apple trees are chiefly attacked, but reports of its ravaging pears have also been received. The larvæ are also found on hawthorn and other wild Rosaceæ.

Life history.

This moth belongs to the group of small moths known as *Tineinæ* and to the genus *Laverna.* Its wing expanse is a little less than half an inch when fully expanded; the front wings are almost entirely black with white bars, but may be mottled with black, dark brown and rusty brown; the hind wings are grey, and, like all *Tineinæ*, have long fringes. The head is almost entirely white. The colour is subject to much variation, some specimens being almost black. The moth appears in June according to Stainton, but all those that have been bred or observed appeared in July; and difference of locality no doubt accounts for a difference in the time of their appearance.

The eggs are apparently laid on the leaves; no definite observations have, however, been made. The larvæ feed first on the leaves; but, as winter approaches, and while they are still quite small, they bore just under the bark of a twig, or into the tip of a shoot, and remain there most of the winter. During January and February the larvæ tunnel right into the young shoots and work up the pith (Fig. E). In this tunnel the caterpillar lives until June; its presence does not prevent the leaves and blossom from unfolding, although later on they flag, turn brown, and die right off (Fig. B). These dead shoots if broken off will be found to contain the Pith Moth caterpillar or pupa, usually situated near the tip of a shoot.



THE PITH MOTH (*Laverna atra*).

A, Moth (magnified, line shewing natural size); B, attacked apple shoot, the upper portion shrivelling up and dying away; C, processes on pupa (magnified); D, pupa (magnified) in a shoot; E, larva (natural size) in a shoot; F and G, larvæ (magnified).

The larva (G) is dull reddish-brown with a deep brown head and first segment; the other segments show more or less traces of pale brown spots, four in a row on the second and third segments, and four placed in a quadrangle on the remaining segments. The two front segments have two lateral spots and the remainder a single lateral spot. The tip is deep brown. When mature the larvæ reach one-third of an inch in length and then pupate near the apex of the shoot they have tunnelled. They reach their full-fed stage during the last two weeks in June.

The pupa (D) is of an ochreous hue; the head and front of the thorax and tip of the body mahogany red. It is cylindrical in form and about one-fourth of an inch long. On the under surface of the last segment but one are two blunt processes, separate and diverging outwards, hairy at their tips (Fig. C); the eyes are black and the wing cases and legs long, the former pointed. This stage lasts from two to three weeks, the moths emerging at the end of June or in July. The pupæ may sometimes be seen projecting from the dead shoots. Stainton says the larvæ also occur in hawthorn berries in September and that the black variety only is found in apple shoots in February and March.

Preventive Measures.

It is quite obvious that there can be no remedy for this pest, but much can be done in the way of prevention by hand-picking the dead shoots before the moths emerge in June. This can only be done, however, where small trees are attacked, and the attack is generally confined to such trees.

Late spraying with Paris green would probably prove beneficial, as it should kill the young larvæ, which seem to feed first of all on the leaves. The trees should be washed not less than four weeks before the fruit is gathered, but as soon as it is harvested a heavy spraying may be given.

The time to spray therefore must depend on the variety of apple concerned. This is certainly worth giving a fair trial, as beyond hand-picking nothing else can be suggested to check the increase of this pest, which has been so noticeable during the past few years.

4, Whitehall Place, London, S.W.,
July, 1903.

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BOARD OF AGRICULTURE AND FISHERIES.

The Pine Beetle (*Hylesinus piniperda* L.).

Fig. 1. Pine beetle magnified about six times.

This is one of the most destructive of forest insects, and in this country, is met with wherever pines are grown.

Description and Life History.

The mature beetle* (Fig. 1) is about one-fifth of an inch long, dark brown or almost black in colour, and thinly covered with brown hairs springing from little tubercles, which, on the wing-cases, are disposed in rows between lines of punctures. These rows of tubercles are continued to the very edge of the posterior margin of each wing-case, except in the case of the second row on each wing-case, counting from the middle of the back, where the hairy tubercles cease at the point where the wing-case begins to bend down towards the apex. The discontinuance of the tubercles in these two rows is the main point of distinction between this insect and *H. minor*, Htg. The latter, however, is as rare as the former is common. The feelers (antennae) are rusty brown in colour, relatively short, and end in jointed clubs. The thorax, except in the middle, is thickly covered with shallow punctures, but not disposed in rows as on the wing-cases. The larvæ are white, bent, and footless, with a brown head.

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The beetles pass the winter under a variety of cover, and take wing during sunny weather in March and April. They at once congregate for breeding purposes on the bark of pines that have died or that have been felled during the previous autumn or winter. Trees that have been dead longer than the period indicated are not attractive to the insects. All kinds of true pines, such as the Scots Pine, Black Austrian Pine, &c., are used for breeding purposes; and occasionally, though very rarely, the spruce, larch, and other conifers are also utilized. Trees or boughs of a size to carry thick rough bark are chiefly infested by the insect for purposes of breeding; young trees, or branches with comparatively thin smooth bark, are largely avoided. The

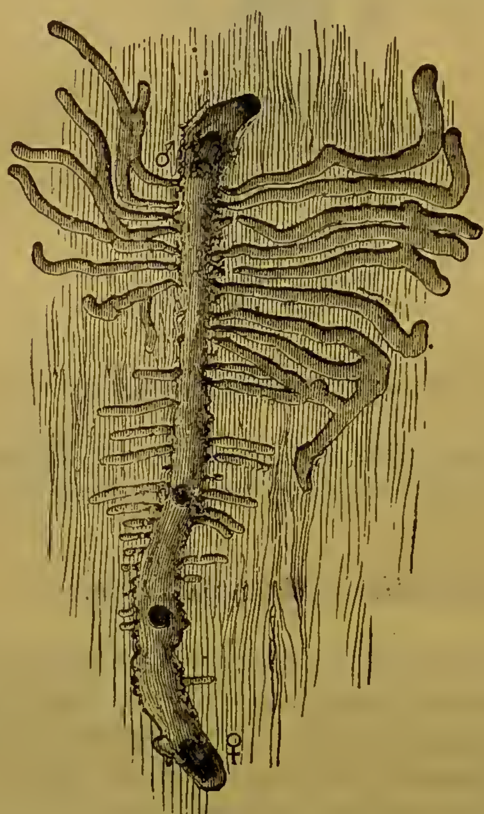

Fig. 2. Mother and larval galleries, showing two air-holes, natural size. The male keeps near the entrance, while the female carries on the work of excavation.

insects pair and proceed to bore into the bark, making a passage between the bark and the wood, the latter, however, being hardly broken. This passage has a slight bend at the starting-point, but afterwards is nearly straight (Fig. 2). It is usually about four inches long, and is generally supplied with one or more air-holes besides that by which the pair of insects entered. In making this gallery the dust is thrown to the outside, where its presence quickly attracts the attention of an experienced observer.

As the gallery is proceeded with the female beetle lays about 100 eggs, depositing them alternately on either side, and these produce larvæ in about a fortnight. The larvæ

proceed to eat into the inner bark (bast) at right-angles to the main passage, and in a month or so they pupate, that is form chrysalids, in the bark. A week or two later the chrysalids change into beetles, which eat their way out to the surface. As it generally happens that a very large number of beetles breed in the same tree, the surface of the bark after the young beetles have emerged looks as though a charge of No. 6 shot had been fired into it.

So far as dead or dying trees are concerned, the action of the insect up to this point is not of serious economic importance. So long as it can get such trees in which to breed, it will not attack healthy trees, but should suitable breeding material not be present it may make its breeding galleries in comparatively sound stems, which will soon be seriously crippled, or killed outright.

The young beetles appear in June and July, and they may do one or other of two things. They may either fly off to other pine stems that have been felled or have been dead for a few months, in which case they pair and breed just like their parents, the progeny appearing two months later. In such an event we have what is called a double generation, that is, two broods in a single season. But more frequently the young beetles that appear in June and July do not breed in the year

Fig. 3. Pine shoot with slice removed to show passage made by the beetle.

in which they are hatched. In this case they fly singly to the young shoots of the Scots or other pine, and into such shoots they bore, usually two inches or so beneath the terminal bud

(Fig. 3). Having reached the pith the beetle bores upwards, but the passage thus made is only occupied for food or shelter, never for breeding, which is only performed underneath the bark of trees in the manner just described.

As a result of the leading shoot of a stem or branch being hollowed out in the centre it generally dies, or is broken off by the wind, and the trees become much deformed. They also loose a considerable quantity of their foliage, and the yield of cones may also suffer to a serious extent, a matter of importance in natural regeneration. It is to this action of the beetle that the chief sylvicultural damage is due. Trees so affected become characteristically mis-shapen, and are easily recognised, even at a long distance. Underneath infested trees, especially after a high wind in autumn, the ground will often be found thickly strewn with the tips of shoots, each with a cavity in the centre, and not infrequently containing the beetle. On young, vigorous trees, especially in a sheltered situation, the shoots do not so frequently break off, but the sickly appearance of the leaves, and an outflow of resin from the entrance-hole, readily attract attention to the damage, and on cutting the shoot open the beetle will often be found at work in the central gallery.

The result of the action of the insect in destroying the ends of the branches, and frequently causing them to drop off, has earned for it in Germany the name of Wood Gardener or Tree-pruner, a designation first suggested by Linnæus.

Young trees, though severely crippled and reduced to the condition of mis-shapen bushes, are not often actually killed by the pine beetle; but old trees, whose shoots are more exposed to the wind, and being thin, are easily broken off when injured, are often completely destroyed by the persistent attack of this insect. Such a result will most frequently be observed in the neighbourhood of a saw mill, or of any place where pine logs are stored. Often, when a small proportion of standard pines are retained to grow when a wood is felled, it is found that such standards become unhealthy and soon die. This result is due to the fact that the felling of the wood has provided the insects with abundant opportunities for propagation (stumps, stools, stems, &c.), and from these in the month of June the standard trees are invaded by swarms of beetles. If the change that is induced in the appearance of their crowns be observed, the appropriateness of the name Tree-pruner will be at once apparent.

Preventive Measures.

Widespread and destructive as this insect is under irrational methods of forestry, it is by no means difficult

to combat. This is secured either by preventing its getting suitable material in which to breed, or by providing it with such material, but taking care that the young beetles are destroyed before they have escaped from the places where they are bred.

Most trees are felled in autumn and winter, and to leave pines lying in their bark in or near woods till the middle of the following summer is a sure way to propagate this and many other destructive forest insects. There need be no fear of the pine beetle breeding in stems from which the bark has been removed, but the barking of winter-felled pines is a somewhat expensive proceeding. The removal of the trees, or their conversion before the month of June, should always be attended to, but the ideal method of procedure is as follows. Let the trees felled in autumn or winter remain in or near the wood till the month of May, by which time they will have attracted most of the pine beetles in the neighbourhood. Before the end of May all such trees should be barked, and as, by that time, the stems will be thickly beset with larvæ, the bark can be removed quite easily. In delaying the process of barking till May the logs are not only rendered unfit to serve as future breeding places, but, what is most important, they are utilized as lures or traps, to which a large proportion of the beetles in the neighbourhood are attracted, and in which they are subsequently destroyed. On no account, however, must barking be delayed beyond the end of May. The bark removed should be deposited so that its inner surface, where the larvæ and chrysalids are found, is freely exposed to the sun and birds, and if this is attended to there is small chance of any of the young insects escaping. It is only when the bark is very thick that there is a likelihood of the immature insects completing their development in the bark after it is stripped off, and, in such a case, burning may be undertaken.

Small brushwood does not offer satisfactory breeding facilities for this insect, but it may serve the purpose for others, so that it is well to destroy it. Large branches, however, should be treated as recommended for stems. The Pine Beetle will also breed in the part of the stools above ground, and in the month of May the bark of stools should be pressed off by means of a spade, or other suitable tool and, being generally thick, should be burned.

All pines that die in the course of the summer should be felled and barked within two months.

By attending to these simple directions most of the damage, from which an important section of our forest trees suffers through the attack of this insect, will be avoided.

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BOARD OF AGRICULTURE AND FISHERIES.

Bunt and Smut.

Both of these are fungus diseases of cereals, and annually cause much damage. Bunt (*Tilletia*) chiefly attacks wheat, and is characterised by the grains being filled by a black mass of fungus spores, which give a fœtid odour, especially when rubbed. Ears that are attacked are lighter than sound ears, and, therefore, stand more erect. They also remain longer green as harvest approaches. So long as the ears are undisturbed the black spore-masses remain unseen; it is only when they are rubbed or bruised in the process of thrashing that they allow the spores to escape.

Smut (*Ustilago*) attacks all cereals, and is characterised by the grains being filled and destroyed by black dusty spores, which, unlike bunt, are quite conspicuous on the undisturbed plant. It is most common on barley and oats, where it may attack a large proportion of the ears. There are several varieties of this fungus, but the distinctions are of no importance to the farmer.

Both in the case of bunt and smut infection takes place when the plant is quite young, the fungus pushing up inside the plant as it grows, until ultimately the immature seeds are attacked in the characteristic fashion.

Prevention always takes the form of treating the seed in such a way that the spores are destroyed before sowing. In the case of wheat the most approved "steep" or "pickle" consists either in pouring the grain into a barrel or other receptacle containing a half per cent. solution of bluestone (copper sulphate) and leaving it there, with frequent stirring, for 12—16 hours, or in spreading the grain on a floor and sprinkling it with a 10 per cent. solution of the same material. The latter is the method most commonly practised in this country, the mode of procedure being to empty a sack (four bushels) on a wooden floor and to water it with 1 gallon of water in which 1 lb. of bluestone has been previously dissolved. The seed should be turned during the progress of the operation, and thereafter it should be turned two or three times, after which it is spread out in a thin layer till it is dry enough to sow.

The same method may be practised in the case of barley and oats, but as it is found that these grains suffer somewhat seriously in germination in consequence of the treatment, resort is preferably had to the hot water system of Jensen.

This is practised by placing, say, 10 gallons of boiling water in a large barrel or tub, and immediately adding an equal quantity of cold water. The whole should then show a temperature of 130—135° F., and care must be taken to secure, but not to exceed, this temperature. Needless to say, a thermometer must be used to determine the point. One bushel of seed contained in a sack or closed basket is then dipped into the water, where it remains for five to seven minutes, when it is removed and spread out to dry. The water in the receptacle is then brought up to the necessary temperature, and a new lot of grain immersed. It is found to be an improvement to soak the grain in cold water four or five hours before placing it in the hot water.

For the treatment of seed oats and barley, recourse has been had, of late years, with great success, to a solution of formalin, used at the rate of 1 pint of 40 per cent. formalin to 36 gallons of water. The seed is placed in a bag and dipped into the solution, where it is allowed to remain for 10 minutes, being afterwards spread out to dry. One pint of formalin, costing about 2*s*., is sufficient for the treatment of 40 or 50 bushels of seed.

When treated with bluestone or formalin solutions, or with hot water, a certain percentage of the grains are destroyed, but as these have frequently been previously damaged in the process of thrashing or otherwise, and are therefore likely to produce weak plants, their total destruction is of less consequence. Seed that has been much rubbed in the thrasher suffers most in steeping. The loss by treatment with bluestone can be somewhat mitigated by dusting powdered lime on the grain after it has lain for a sufficient time in contact with the solution.

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BOARD OF AGRICULTURE AND FISHERIES.

Farmyard Manure.

The substance that goes by the name of farmyard manure, fold manure, dung, or muck, chiefly consists of (*a*) the material that was used as litter, usually straw, sometimes peat, fern, sawdust, &c.; (*b*) the food that passed through the animals in an undigested condition and has been voided in the solid form; and (*c*) the urine, which contains that part of the food which the animals digested but did not retain in their system. The urine also contains the waste of the tissues of the animal's body. The proportions of these parts will vary with circumstances. For instance, when it is the object of the farmer to break down as much straw as possible, a relatively large amount of the farmyard manure will consist of litter, but where litter is used very sparingly—as in upland dairies—the manure will consist very largely of the solid and liquid excreta.

All food contains more or less water; even in such substances as grain or cake one-seventh or one-eighth, while in others, like turnips, nine-tenths is pure water. Neglecting this water, it may be said that for every 100 lb. of food that an animal consumes, about 50 lb. reappear in the dung or urine; the other 50 lb. being burned up in its system, becoming gas or water, or being stored up in its body as bone, flesh, fat, hair, &c. A well-grown bullock or cow—weighing, say 9 cwt.—will consume daily, if on full ration, about 24 lb. of absolutely dry food, as for example:—

56 lb. Roots (90 per cent. water)	... =	5·6 lb. dry.
6 „ Cake or Meal (12 per cent. water)	=	5·3 „
16 „ Hay or Straw (16 per cent. water)	=	13·4 „
Total	...	24·3 lb. of dry matter.

One-half of this, say 12 lb., will reappear as manure, and to this has to be added the whole of the dry matter in the litter, say 10 lb., making the daily output of dry matter in

farmyard manure 22 lb. Needless to say, it may be much more or much less, depending on the age and size of the animals, and on the way in which they are fed and littered. Ordinary farmyard manure is, of course, not dry; on the contrary, it contains about 75 per cent. of water. The daily output will therefore weigh not 22 lb. but 88 lb., say ¾ cwt. Thus on a six months' keep the amount of farmyard manure yielded will be about 7 tons. This calculation applies to full-grown cattle; if the stock consists, as it generally does, of a fair proportion of younger animals, the output per head may be only 3 or 4 tons. It follows that on a farm with a mixed stock of 50 head, comprising 3 or 4 horses, enough dung should be produced during winter to give a dressing of 10 or 12 tons per acre to about 15—20 acres of land, or 3—4 acres less when allowance is made for loss during storage.

From the manurial point of view the three substances that are of most importance in the food are nitrogen, phosphoric acid, and potash. Although only one-half of the solid matter in the food reappears in the manure, at least three-quarters of the nitrogen, and nine-tenths of the phosphoric acid and potash, are voided. These proportions will be considerably reduced in the case of very young animals, and increased in the case of fattening cattle. Of the nitrogen that passes through an animal a larger proportion finds its way out in the urine than in the solid excreta. The same is true of the potash, whereas the phosphoric acid—*i.e.*, the phosphates—are chiefly voided in the dung. It will thus be seen that two of the three valuable elements of plant-food are more abundant in the liquids than in the solids of animal excreta, and, not only so, but, pound for pound, the substances in the liquids are much more valuable for crops because they are much more readily available. The Rothamsted experiments have shown that much of the nitrogen in the solid part of dung can hardly be said to be of any use to plants, whereas the nitrogen of the liquid portion is almost as active and therefore as valuable as nitrate of soda or sulphate of ammonia.

In a ton of ordinary farmyard manure there is as much nitrogen, phosphate, and potash as in twelve or fifteen shillings' worth of artificial manure, and if a ton of dung is not usually valued at even half these figures this is chiefly because a large part of the three substances mentioned never becomes available, or is lost before crops can make use of it. True, a ton of farmyard manure is more expensive to handle than 2 or 3 cwt. of artificials, and this, of course, reduces its relative value; but, on the other hand, farmyard manure has a beneficial influence on crops just because it is a heavy bulky substance, so that these two considerations may be held roughly to balance or cancel each other.

Variation in the Quality and Character of Dung.

This is affected by :—

The Kind of Food.—Food rich in fertilising materials, especially nitrogen, produces rich dung.

The Kind of Animal.—Horses produce dry, hot dung that ferments and acts quickly, but does not last long, whereas the dung of cattle and pigs is cold, slow-acting, and more durable. The dung of young stores and dairy cows is rather poor in all the important elements of plant-food, because, in the former case, these elements have, to a relatively large extent, gone to form bone and muscle, while in the latter case they have found their way into the milk. For instance, to quote the Rothamsted figures, while the excreta of a fattening bullock getting decorticated cotton cake will contain about 97 per cent. of the nitrogen, 96 per cent. of the phosphoric acid, and 99 per cent. of the potash present in the cake, the corresponding figures for a milk cow are only 87 per cent. for the nitrogen, 89 per cent. for the phosphoric acid, and 86 per cent. for the potash. This means that for every 3 lb. of nitrogen, 4 lb. of phosphoric acid, and 1 lb. of potash that the fattening bullock abstracts, the milk cow appropriates 13 lb., 11 lb., and 14 lb. respectively.

The Age of Dung.—Rotten dung is richer and more active, provided it has been properly "made," than comparatively fresh undecomposed material.

The Manner of Storage.—Properly-managed dung is more valuable than that which has been mismanaged

Treatment of Dung in the Homestead.

Attention should be given to :—

The Prevention of the Escape of Liquids, for these hold the larger and much more valuable part of the plant-food. These may drain into the ground if the floor of the yard or dung-heap be porous, therefore the surface on which the mass rests must be water-tight. More frequently, perhaps, they are allowed to run away in a surface stream, and unless this can be led on to a meadow or other field, the loss may be very serious. The floor of the dungstead should not only be impervious to the passage of liquids, but it should have a distinct slope backwards, so that the front is two or three feet higher than the back. No doubt concrete is the most satisfactory form of floor, but no great waste, if

any, will take place through a foot of well-beaten clay overlaid by rubble.

Over-heating is productive of loss in various directions. The heat that is always more or less associated with a mass of dung shows that actual burning is going on, and, in the process, nitrogen escapes into the air. The weight of organic matter is also reduced, and as part of the value of farmyard manure is due to its being a bulky organic substance, it is undesirable to have this substance largely consumed in the dung-heap. During a winter's storage the loss of weight will usually be about 20 to 30 per cent., but it may be double this, and when the loss is excessive the capacity of the mass to suck up and retain liquids is correspondingly reduced. Moderate decomposition cannot be avoided, and is not to be regretted, for if no loss has occurred by drainage, and but little by the air, the smaller mass will contain practically all the original plant-food, and this, too, in a more portable and convenient form. If, for instance, 5 tons have shrunk to 4 tons the value of the latter quantity should be as great as the former, so that if 5 tons of fresh dung are worth 15*s.*—*i.e.*, 3*s.* per ton—4 tons of matured dung will still be worth 15*s.*—*i.e.*, 3*s.* 9*d.* per ton.

Over-heating is avoided by keeping the mass well compressed; and this is secured by the treading of animals—as in yards, courts, or boxes,—or by wheeling each barrow-load or cart-load over what was there before, or by loading on soil or rotten turf. The mass should also be kept saturated with moisture, and this is best secured by preventing the escape of liquids. With dung of a very dry character (horse manure), especially in a covered dungstead, it may be desirable to add water, but only if there is no chance of superfluous moisture escaping by drainage.

If manure is stored in a compact, deep dungstead, with a properly constructed floor, and if care be taken to prevent its getting more water than falls directly on it in the form of rain or snow, there is no need to cover it in. Loss by excessive washing can be better prevented by other means than by erecting a roof over the mass. It is obvious that the advantages of a covered dung-heap will be greatest in a district of heavy rainfall, but in any case it is doubtful if it will pay to provide a roof for the dungstead unless it can be also used as a cattle-shed.

Many farmers prevent loss due to escaping liquids by leading these directly on to the land, or by conducting them to a tank which is periodically emptied into a liquid manure cart and distributed over the land. If the character and lie of the fields suit such methods of treatment, they are in every way commendable, but local circumstances often make it difficult or impossible to carry them out.

Over-heating and excessive loss of weight are obviated by compression and saturation, simply because the dung-heap under these conditions contains comparatively little air, and air is a necessity of fermentation and decomposition.

To bring raw manure into a rotten condition, farmers often turn it over once or twice, the result of which is that air permeates the whole mass, and great heat is developed, with corresponding loss of weight. No doubt there are circumstances where such treatment is expedient; but, considering the cost of labour and the loss of organic matter, and, to some extent, of nitrogen, it is probable that the process is often performed when it would be better avoided. The familiar example of the slow combustion of a "backed" or "banked" fire of coals is strictly comparable with what takes place in a well-packed mass of dung, while in both cases rapid combustion, with concurrent disappearance of solid material, will follow vigorous stirring.

Equality of Composition throughout the whole mass should be secured as far as possible, or otherwise the best results both in the heap and on the crop will not be secured. The dung from the stable, cow byre, feeding byre, store byre, and piggeries has, in each case, its own characteristics, and the mingling of all will produce, on the whole, better material than having the horse dung in one part, the cattle dung in another, and the pig dung in a third. The wet, inert, cold character of byre dung will add moisture to the stable dung and prevent its being over-heated ("fire-fanged" it is sometimes called), while the rich manure from the feeding boxes will improve the quality of the dung of the store cattle.

Conservation Agents.

From time to time attention has been directed to the prevention of loss in manure heaps through adding gypsum, superphosphate of lime, kainit, or sulphuric acid. On the whole, it cannot be said that any of these has much effect. The admixture of soil with dung, however, is always to be recommended, provided such material can be obtained at little expense for labour. To give the best results, the soil so employed must be of a loamy character, and, if possible, rich in organic matter. Its effects are to fix ammonia, to encourage the formation of nitrates, to assist in consolidating the mass, and to suck up and retain liquids. Needless to say, soil so employed must not contain the seeds of troublesome weeds or the germs of plant-diseases, such as finger-and-toe. Moss litter or peat is also an excellent fixer of ammonia and absorbent of liquids, and, if for nothing else than to improve the manure heap, it is a good plan to have a

little in use for some of the live-stock. Such peaty manure unless it is being used in a yard, should daily be spread in the dungstead, and the quality of the resulting mass will be thereby appreciably improved.

Treatment of Dung in the Field.

To save carting in spring, or to empty the dungstead or the yards, it is a usual practice, in the course of the winter, to form large field storage heaps. Doubtless, in most cases, this practice is thoroughly justifiable, though the fact cannot be overlooked that the opportunities for loss in such heaps are much greater than in a proper dungstead, so that field heaps should only be formed if they are the means of gaining an important end. Where these heaps must be formed they should be placed on firm, level ground, and they should be made as deep and firm as possible. The so-called "draw heaps," on to which each cart-load is drawn, thereby consolidating the mass, are the best. Subsequently the sides are trimmed up, and the whole should be covered with a layer of soil or ashes about a foot thick. Such a covering consolidates the mass, prevents to some extent ammonia rising into the air, and runs off rain water.

When dung comes to be spread on the land, it should be distributed as equally as possible. Sometimes, unfortunately, one sees great lack of care in this respect. In some districts dung is roughly spread straight from the cart, the finishing touches being subsequently given. In other districts, and more frequently, it is laid down in small heaps about six yards apart. If it is immediately spread, no objection can be taken to the system, though it may be said that if the dung is very old, and especially if it is largely made from moss litter, the spots on which the heaps rest are apt to be left over-manured, and especially is this the case on rough meadows. Too often one sees these small heaps lying for days, and even for weeks, unspread, with the result that the rain washes "the goodness" from the dung into the patches on which the heaps rest. These patches are consequently over-manured, whereas the rest of the field, being supplied with impoverished dung, suffers from insufficient nourishment.

With farmyard manure, even more than with artificials, the farmer should so arrange matters that the quantity of dung at his disposal is distributed over as large an area as is consistent with practical convenience. For instance, twenty tons of dung spread equally on two acres will give a much better return than the same quantity spread on one acre, and yet this rule is often neglected.

As regards the time of year when dung should be applied, much depends on the circumstances of the particular case.

By far the greater quantity of dung goes on to meadows and green crops, and it may be said that in the former case autumn or early winter is the best time to make the application. The complete stocking of the ground with plants obviates much loss of soluble matters by washing. On farms entirely under grass there is no choice but to employ the dung on meadows or pastures, and on such farms it would be bad practice not to cart out all available dung in autumn. Of course, the dungstead will again fill up during winter, and on the whole it is probably better to distribute this additional supply in spring than to leave it in the heap, subject to waste and yielding no return, till the following autumn. Late spring dressings, however, unless the dung is very "short"—*e.g.*, dung made with moss litter—interfere with the work of the mowing-machine, though this can be avoided by chain harrowing and raking the roughness off two or three months after dressing.

In the case of green crops part of the dung may with advantage be ploughed in during autumn, but only on clean strong land in a dry district. But if foul and especially strong land has to be cleaned in spring it will be found that autumn dung, by holding moisture, retards the getting of the land into condition in spring. In any case the work of the cultivator brings much of the dung to the surface, and this, being collected with the weeds, is carted off the land again, or possibly wasted by burning. Farmyard manure ploughed in during autumn will decay more rapidly—and especially so in a mild winter—than if left in the dung-heap, so that a relatively larger proportion will be available for the use of the first crop. But just on this account the succeeding crops will not get so much benefit, and this fact has to be borne in mind in estimating the respective advantages of autumn and spring dressings.

4, Whitehall Place, London, S.W.,
August, 1903.

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BOARD OF AGRICULTURE AND FISHERIES.

Millipedes and Centipedes.

FIG. 1.

FIG. 2.

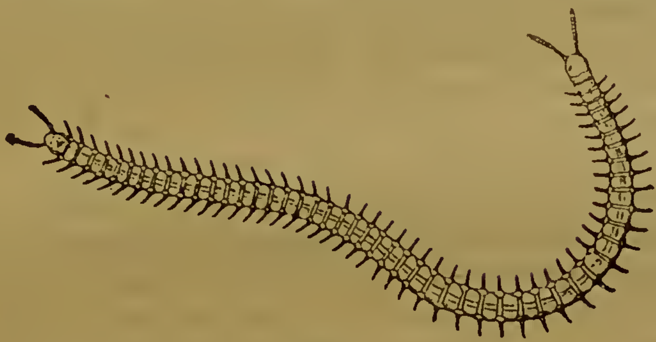

FIG. 3.

Figs. 1 and 2, Millipedes (1, *Julus pulchellus*; 2, *Polydesmus complanatus*); Fig. 3, Centipede (*Geophilus subterraneus*).

Millipedes and centipedes belong to a group of the animal kingdom known as the *Myriapoda*. They are not far removed, in relationship, from insects, but are distinguished by their body showing only two regions; a head, followed by a number of resembling rings or segments, all of which carry one or two pairs of legs.

Both millipedes and centipedes may be found in dark and damp places, under stones, bark, or decaying wood, in loose soil, at the roots of plants, whilst they are especially attracted by decaying vegetation, such as heaps of leaf-mould, rotting stalks, &c. There are differences between them both in food habits and structure, and as, on the whole, centipedes are useful while the millipedes may be distinctly harmful, these distinguishing characteristics should be noted. They may be contrasted thus:—

Centipedes.

Antennæ longer.

Body usually flattened.

Bases cf legs wider apart.

One pair of legs to each segment.

Poison claws showing below the mouth, with poison glands.

Active and carnivorous, feeding on insects, insect larvæ, worms, snails, and slugs.

Millipedes.

Antennæ shorter, not more than seven joints.

Body round.

Bases of legs close together.

Two pairs of legs to each seeming segment, except the front four.

No poison claws.

Vegetable feeders, destructive to the roots of plants and to underground storage organs, like tubers and bulbs.

Millipedes are sometimes known as "false-wireworms," but they can be readily distinguished from the true wireworm (Leaflet 10) by the great number of legs.

Description and Life-History.

Millipedes.—The most injurious millipedes belong to the families *Julidæ*, which have more than 30 rings to the body, and *Polydesmidæ*, with 19 body rings. The most troublesome millipede is *Julus pulchellus* (Fig. 1). This is nearly half-an-inch long, slender, about the thickness of a fair sized pin, pale yellowish-pink in colour, with a double row of crimson or purplish spots on it. *Julus terrestris*, another common species, is black and has a pointed tail. These *Julidæ* feed upon all manner of roots. The smaller *Julus pulchellus* also eats into potatoes and lily bulbs, often hollowing them out completely ; the larger species, according to some observers, also feed upon snails, slugs, and some insects. The common species of *flattened* millipedes, *Polydesmus complanatus* (Fig. 2), is of a pale purplish-white to dull rosy tint, with the sides notched, and may be when mature about an inch long. This species can also be very mischievous at the bulbs and roots of various plants.

The female *Julus terrestris* deposits her eggs from May to July in a nest made of pieces of earth fastened together with saliva ; this nest is round in form, is smooth inside and rough outside, and has a small hole at the top through which the eggs are passed. The eggs vary in number from 60 to 100. The hole is then stopped up and the eggs mature in from 10 to 14 days. The young millipedes have only three pairs of legs, the others appear in groups by degrees. Growth in a millipede takes place by lengthening at the posterior end, the growth evidently taking place between the penultimate and last segments.

Centipedes.—Centipedes, or *Chilopoda*, are beneficial, the diet being carnivorous chiefly, *e.g.*, snails, slugs, and ground insects. Two of the commonest genera are *Lithobius* and *Geophilus* (Fig. 3). The eggs of *Lithobius* are laid from June to August ; they are about the size of a number five shot, spherical in form, and covered with a sticky slime. The female after laying an egg receives it—as Sinclair has shown —on two little hooks at the hind end of the body and rolls it round and round until it is all covered with soil, when, resembling a grain of earth, it is safe from the voracious male. A small number only are laid by each female ; the males frequently devour the eggs before the female coats them with earth. In other genera the number of eggs probably varies. *Geophilus* is said to lay its eggs in an earthen cell.

Methods of Prevention and Remedies against Millipedes.

1.—These pests are frequently distributed with leaf-mould, which should, therefore, be examined before being used, and if found to contain them should be mixed with lime.

2.—Their numbers in the field may also be lessened by broad-casting lime over the surface and working it into the soil.

3.—Soot-and-water, in the proportion of a handful of soot to half-a-gallon of water, is found to drive them away from the roots of garden plants for a time.

4.—They may also be trapped in numbers by placing just under the ground, near the plants they are attacking, pieces of mangolds which have been scooped out. The millipedes swarm over the baits and may then be collected and destroyed.

5.—A certain way of killing them on small areas is by injecting bisulphide of carbon into the soil.

6.—They may be poisoned by baits of decaying cabbage leaves or decaying roots soaked in Paris green and placed here and there in the garden.

4, Whitehall Place, London, S.W.,
October, 1903.
Revised, August, 1905.

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BOARD OF AGRICULTURE AND FISHERIES.

Ringworm in Cattle.

Ringworm is a disease which may attack any of our domesticated animals, but is most frequently seen on cattle. It is also transmissible to human beings.

It evinces a decided preference for young animals, such as calves and yearlings, and for stock that are in poor condition.

The disease is due to the attack of a microscopic fungus (*Trichophyton tonsurans*) which establishes itself at the base of the hair, which in consequence becomes brittle and breaks off. The presence of the fungus also causes the epidermis of the skin to become thickened and wrinkled. In this way bare, gray, scaley patches, two inches or more in diameter appear upon the animal, especially on its head and neck, though also on other parts of its body.

As has been indicated, animals in low condition are most apt to be attacked, so that a preventive measure is to keep young stock in good condition.

The disease is not difficult to cure, the substances employed for this purpose being very varied. Many of them depend for their effectiveness on so smearing the affected patches that the fungus shall be smothered for want of air. In order to enable any substance employed to get thoroughly into contact with the disease, the part attacked should first be well washed with soft soap, or better still, with a solution of washing soda. Then the patch may be dressed with one or other of the following :—

(*a*.) Train oil, five parts, sulphur, one part.

(*b*.) Lard, five parts, sulphur, one part.

(*c*.) Lard, five parts, iodine, one part.

(*d*.) Lard, five parts, oleate of copper, one part.

(*e*.) Soft soap, five parts, sulphur, one part.

(*f*.) Sulphuric acid, one fluid drachm, glycerine, three fluid drachms.

Other substances employed, more or less successfully, are paraffin oil, lime made into a paste, and mercurial ointment.

The last-named, however, being highly poisonous, should only be used under the advice of a veterinary practitioner.

The disease is very contagious, and will linger on the woodwork of stalls, rubbing posts, &c., for many months. These should therefore be cleansed by a weak solution of carbolic acid, or by whitewash, or some other disinfecting agent.

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BOARD OF AGRICULTURE AND FISHERIES.

Milk Fever or Parturient Apoplexy.

Parturient Apoplexy, also called Milk-Fever, Dropping after Calving, etc., is a disease of cows, more especially of milking breeds; and chiefly occurs at the time when they have attained their fullest milking capacity. It has been recognised for generations and has been a fruitful cause of loss to the agricultural community, the deaths in many instances averaging from 40 to 60 per cent. of all cows attacked.

Symptoms.

The disease generally commences within from 12 to 48 hours after an easy parturition, but it may be delayed for a few days longer. (In only extremely rare cases has it come on *preceding* parturition, or *later than* six days afterwards.)

The first noticeable symptom is sudden cessation of feeding, rumination, and lacteal secretion, with uneasiness, moaning, a dull expression of the eyes, paddling of the hind legs, rapid breathing, swaying from side to side, and knuckling over of the fetlocks. Later on the cow drops. This may be succeeded by a stage of excitement, characterised by throwing about of the head and bellowing, but more frequently the cow passes into a semi-conscious sleepy condition, and is unable to rise. She remains in this state, moans slightly, and assumes a characteristic posture, with her neck flexed laterally and her nose touching the point of her shoulder.

As the disease progresses the cow becomes comatose, is unable to see, to swallow, or to void excreta; distension of the belly sets in and death supervenes.

Methods of Prevention and Treatment.

The nature of preventive treatment largely depends on the conditions under which the animals are housed; but the principle involved is always to bring the animal into a condition of body most nearly resembling the natural.

If the cow is very fat, reduce her condition by diminishing the amount and the richness of the food supplied for a week or so, before and after parturition; this may be assisted by a judicious use of mild purgatives.

If the surroundings are suitable, the cow, for a fortnight before she is due to calve, might be turned out to graze in a field in which the grass is not too abundant and where she would require to move about in search of her sustenance.

trading associations. Their usual function is to purchase *wholesale*, manures, feeding stuffs, seeds, implements, and other articles used on the farm. By purchasing in large quantities direct from the manufacturer, these societies are able to obtain supplies for their members at wholesale prices. In this way they not only help the small farmer to procure his manures and feeding stuffs at a more moderate price than he could do by purchasing for himself alone, but they also save him a large part of the incidental charges usually incurred by the individual buyer in the carriage and testing of the goods. For instance, only one analysis is required of a fertiliser or feeding stuff consigned in truck-loads to the society to test the quality of the several portions of the consignment bought on behalf of individual members, while each member benefits by the lower rates of carriage obtained by collecting sufficient orders to make up loads of four tons and upwards.

Co-operation in production has been applied with greatest success to the dairy industry. The remarkable development of the butter trade of Denmark is attributed largely to the establishment of co-operative dairies and creameries, which have enabled the farmers of that country to supply the British market with immense quantities of butter of uniform quality. Uniformity in flavour, in appearance, and in consistency, is the characteristic most required in butter intended for general consumption in the great towns of this and other countries; and it is obvious that this is more likely to be secured by manufacturing the article in dairies which can manipulate the milk supplied by a large number of farmers, than if each of these farmers himself makes butter from the milk produced on his own farm. A full account of the organisation and methods of the Danish dairy societies, and of similar associations in Sweden and Germany, is given in a special report published by the Board of Agriculture, and articles showing the progress of co-operative dairying abroad, in the colonies, and in Ireland, have appeared from time to time in the pages of the Board's Journal. Except in the case of butter and cheese-making, little advance has been made in the application of co-operative principles to productive processes in agriculture. Danish farmers have, however, associated for the curing of bacon for export, and there are also instances abroad of agriculturists having combined with satisfactory results for the prosecution of such businesses as milling, baking, distilling, the preservation of fruit and vegetables, sugar refining, the manufacture of starch, and the raising of seeds.

Co-operation in the sale of general agricultural produce presents difficulties which have not yet been successfully overcome. When it is remembered that corn, vegetables, and meat are usually sold wholesale in separate markets

under entirely different conditions, it is not surprising that comparatively few farmers' associations have attempted to undertake the sale of all these articles on a large scale. These difficulties are less conspicuous in cases where the societies have confined their business to a single class of produce, such as butter and eggs, and the wholesale disposal of these products on co-operative lines has been organised with success. Where this business has assumed large dimensions, as in the case of the sale of butter manufactured in the Danish and Irish dairies, the work of distribution is undertaken by special agencies formed solely for that purpose, to which the dairies consign their produce. This form of co-operative distribution is one which offers great possibilities in connection with the question of the economic carriage by rail of agricultural produce. Many of the complaints made by farmers of excessive and preferential railway charges arise from the fact that the consignments concerned are not sufficient in bulk to enable the companies to handle them with profit at the lower charges at which they convey larger consignments. In such cases the remedy would frequently be found in the formation of a co-operative distributing agency, which would undertake the collection and packing of small consignments to make up trucks-loads for dispatch at regular intervals.

Retail trading has been taken up by some co-operative societies in dairying districts on the Continent, through the medium of the parcels post, and this means of reaching the consumer direct has also been employed for the distribution of fancy cheeses, honey, eggs, and fruit.

Among the other co-operative institutions established by farmers on the Continent, perhaps the most important are the associations for the improvement and insurance of live stock, which are more numerous in France and Belgium than elsewhere. As a rule cattle are the animals with which these associations are concerned; only in a few instances are horses, sheep, and swine included. In the case of the Belgian cattle insurance societies, which may be taken as a type of these institutions, the usual compensation allowed to members for the loss of an animal is two-thirds of its value, and this is paid out of the funds of the society, to which all the members make periodical contributions. Another method adopted by some societies is to pay the compensation out of the common fund only when the animal is declared unfit for food; but if the meat is suitable for human consumption it must be purchased by members of the society, each contributing to the price a sum proportionate to the number of animals he has insured in the society. In some societies there is, however, no common fund, and then the practice is to compensate the owner of a condemned animal by levying a subscription on all the

members to make up its value if the meat has been seized: or if the meat may be used for food then the society purchases the carcase and distributes the meat amongst the members at an agreed price. In this country so-called "Cow Clubs" are sometimes met with among cottars and farm servants for the purpose of compensating the members in the event of the death of their cows, but unfortunately the custom of keeping cows by cottars is not so common now as formerly, and many cow clubs have been dissolved.

All the forms of association to which reference has been made have been adopted to a much greater extent by farmers abroad than by the agriculturists of the United Kingdom, and are one important cause of the success of the foreign competition in fresh agricultural produce, such as butter and eggs, which is now felt to so large an extent by the home producer. The co-operative movement has, however, made much progress amongst Irish farmers since the work of organisation was taken up by the Irish Agricultural Organisation Society in 1894. At the end of 1902, there were in Ireland 712 farmers' co-operative societies, with 71,023 members. These included 122 agricultural societies, 334 dairy societies and auxiliary creameries, 145 agricultural banks, 31 poultry societies, 49 home industries societies, 18 bee-keepers' societies, and 13 societies with miscellaneous objects, such as the promotion of the flax industry and fruit growing, and including also three federations of societies.

The chief function of the agricultural societies in Ireland is the joint purchase of agricultural requisites, especially manures. Some of these societies have also undertaken sales of live stock; others have been useful in procuring implements and spraying machines, which are hired out to the members at a small charge; and three have hired grazing lands and let them out at reduced rents to their members.

The Irish dairy societies or creameries, whose main business is the manufacture of butter, are organised on the lines of similar associations in Denmark, and their process of butter-making follows closely the Danish system. Few of the Irish dairy societies were started with sufficient share capital to cover their outlay in buildings and machinery. In many instances, credit was obtained from the contractors, or the extra capital required was raised by means of a loan from a local bank. The shares in the dairies are owned, for the most part, by the members. In some cases, persons who do not keep cows hold shares, but they have become shareholders to help the associations as social institutions rather than for the purpose of investment Shares are usually taken up by farmers in proportion to the number of cows they keep, at the rate of £1 for each animal. This arrangement, however, is not uniform in all

the societies. It is the practice to pay for the shares by instalments, generally of five shillings at a time. After the creamery has been started, these instalments are frequently paid in milk : sometimes a reduced price is allowed for the whole of the milk delivered, and sometimes the member delivers a certain quantity free of charge, until the call on the share is paid up. The liability of the farmers is, in all cases, limited to the amount of their shares.

The accounts for 1900 of 195 of these dairy societies, with a membership of 33,064, showed a paid-up capital of £77,282, and a loan capital of £46,204. The value of their buildings and plant, after allowing for depreciation, was estimated at £130,818. The quantity of milk handled by them in the year was 37,162,000 gallons, from which 15,394,500 lbs. of butter were produced. The average price paid to members for milk delivered to the societies was 3·97*d.* per Imperial gallon; and the net profit on the operations of all the societies, after deducting working expenses, was £14,576.

The co-operative poultry societies in Ireland have confined themselves as a rule to the collection and sale of eggs on behalf of their members, but some of them have recently embarked in the table-poultry trade. They purchase eggs as well as poultry from their members *by weight*, and the introduction of this practice is said to have had the effect of making poultry-keepers more interested than before in maintaining a good breed of fowls.

In every case the price paid for the eggs sold through the societies has been above that obtained before they were started. It is claimed that the societies have accomplished an incalculable amount of useful work for the poultry industry of Ireland by raising the standard of quality, by introducing new and improved methods of keeping fowls, and by procuring for their members birds of serviceable pure breeds.

In Great Britain the co-operative movement has hitherto advanced very slowly amongst agriculturists. There are, however, several old-fashioned associations for the joint purchase of manures in England, and a number of similar bodies exist in Scotland. Among the English institutions of this class, one of the oldest is the Lincolnshire Farmers' Association, established in June, 1868, for the purpose of purchasing genuine phosphatic manures of guaranteed quality, and supplying the same to its members at cost price. This society is organised on a strictly co-operative basis : no profit is made on its transactions, and the working expenses are defrayed by an entrance fee of twopence per acre on the land occupied by each member, and by a fee of one shilling per ton on the goods ordered. All manures are analysed free of cost to the members, and delivered carriage free within a certain area. In 1901 this association distributed

6,400 tons of superphosphate to its members, and its accounts for that year show a turnover of over £19,000 It is maintained that by the influence of the Lincolnshire Farmers' Association, the price of manures has been considerably reduced, and that consequently thousands of pounds have been saved by the members, and by others connected with the cultivation of land within the sphere of the Association's operations.

A few other Farmers' Supply Associations exist in various parts of Great Britain, but most of them differ from the Lincolnshire Association in the sense that they are run as large stores or companies with considerable share capital upon which dividends are paid.

In addition to these large associations, there are to be found, here and there, in some of the western counties of England, local manure clubs working on a small scale on the lines of the Lincolnshire Association; and a number of analytical societies of the same type exist in Scotland. But the benefits to be gained from the formation of societies of this class have not yet been recognised by the great body of occupiers of small holdings and allotments south of the Tweed, amongst whom there is a great scope for all forms of co-operation.

The task of organising agricultural co-operative associations in Great Britain has been recently taken up by the Agricultural Organisation Society, which has been founded for the same purpose as the kindred society in Ireland. The objects of this society, as stated in their report, are to secure the co-operation "of all connected with the land, whether as owners, occupiers, or labourers, and to promote the formation of agricultural co-operative societies for the purchase of requisites, for the sale of produce, for agricultural credit banking and insurance, and for all other forms of co-operation for the benefit of agriculture." The society carries on its work by sending organisers to address meetings and to give advice as to the proper course to be pursued in the formation of local societies; by providing model rules for such local societies; and by publishing leaflets from time to time dealing with the various forms of agricultural co-operation. The local societies affiliated to this central organising agency already number 52, including 29 co-operative agricultural trading societies or joint purchase associations, six dairy associations, one for the production of cheese, three allotment societies, one basket-making association, six combining the purchase of agricultural requirements and the sale of produce, four joint purchase societies also undertaking the improvement of stock by the purchase or hire of pedigree bulls or boars, one entire cart horse society, and one land association. Many of these bodies have only recently commenced operations; but as an example of the advantages of co-operation to the small

farmer, reference may be made to the published accounts of the work already accomplished by two or three of them.

The Muskham Agricultural Society may be quoted as an example of an agricultural trading association. This was started in May, 1899, with 17 members and a share capital of £16. In 1900 the membership had increased to 38, and the turnover amounted to £365. One of the first steps taken by the society was to purchase a reaper and binder with money borrowed from a bank on the joint personal credit of the committee. The scale of charges for the hire of the machine was last year fixed by the committee at the rate of 4*s*. 6*d*. per acre, the society providing twine, and a man to take charge of the machine and horses. The result of three seasons' work has been that the society has liquidated the debt to the bank and the machine now belongs to the members, who can avail themselves of its use at a nominal charge just sufficient to cover wear and tear.

Some of the agricultural trading societies are also able to assist in the improvement of the live stock kept by small farmers by purchasing or hiring first class bulls, boars, and stallions. The Tregaron Agricultural Society, a small co-operative body of 50 members holding shares of 5*s*. each, of which 1*s*. 6*d*. is paid up, has, in addition to its business in manures, cakes and seeds, secured for its members, free of charge, the services of a boar, which is hired out to non-members at a fee of 2*s*. 6*d*.

Among the affiliated dairy societies, mention may be made of the Brandsby Dairy, in Yorkshire, which is chiefly engaged in the sale of butter, cream, and cream cheese on behalf of its members, but also undertakes to supply them with manures, feeding stuffs, and other farming requisites. A small warehouse has been rented by this society from the railway company, in which the manures, cake, and other articles purchased in bulk are stored, and from which they are distributed to members as a return-load for their carts which have brought produce to the station. By purchasing in truck-loads and relieving the dealer of the risk of bad debts and the trouble of collecting small sums of money from a number of individual buyers, this society has been able to obtain reduced quotations by which every member has benefited, however small his purchase.

The local societies affiliated to the Agricultural Organisation Society* are registered under the Industrial and Provident Societies' Act, and can therefore sue and be sued as corporate bodies.

The foregoing examples are sufficient to afford some idea of the directions in which farmers, and particularly occupiers

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* The Secretary of the Agricultural Organisation Society, Dacre House, Dacre Street, Westminster, to whom the Board are indebted for assistance in the preparation of this leaflet, will be pleased to furnish information and afford advice to persons interested in the formation of agricultural co-operative societies.

of small holdings, can effectively combine to their mutual advantage. Hitherto the Agricultural Organisation Society has been working single-handed to encourage and assist such combination. But its efforts can now be seconded by County Councils in rural districts where co-operation is likely to be useful, the Board of Education being prepared to sanction the teaching of the principles and practice of agricultural co-operation in the case of all County Councils which may make application to them in terms of Section 8 of the Technical Instruction Act, 1889, provided the Board are satisfied that such a form of instruction is required by the circumstances of the district.

4, Whitehall Place, London, S.W.,
December, 1903.

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BOARD OF AGRICULTURE AND FISHERIES.

Grading and Packing Fruit and Vegetables.

Intensive cultivation has been carried in many places to a high pitch of excellence, and British horticulturists pride themselves, justly, upon their skill as producers. Admirable and necessary as the highest cultivation must always be, yet something more is required to ensure complete commercial success, namely, the conveyance of the produce in the best possible style to the market or to the consumer. It is at this point too many fail, and a material proportion of unprofitable sales is mainly attributable to neglect in presenting goods in the most satisfactory manner. Proofs of this defect are evident in every British market, and commonly the produce of the home grower may be seen in direct contrast with that of his foreign competitors, to the conspicuous disadvantage of the former. It is the purpose of the following notes to give some directions that, with the exercise of intelligence in carrying them out, may assist in improving the selling value of both fruits and vegetables as produced in this country.

To aid in grading fruits to the best advantage, it must be assumed that the preliminaries of successful cultivation have received due attention. The selection of the best varieties, suitable sites and soils, with every possible care in protecting the trees from attacks of insects and diseases, demand the cultivator's utmost skill and unceasing watchfulness. Finally, in preparing for the actual work of grading, the method and time of gathering should receive the strictest attention, or much of the other labour will be reduced in value. It is not sufficiently recognised how readily all fruits are injured by rough handling. Even hard, unripe, apples and pears are soon bruised, and not only do these marks show as serious defects in the appearance of the fruits, but the keeping qualities are also affected.

One general rule is applicable to all fruits, and that is they should never, if it can be avoided, be gathered when they are wet, especially if they have to be packed for sending a long distance.

In preparation for sorting, the fruits should be taken and carefully spread on a table or bench, which may slightly slope to the front, and should be of a convenient height for the packer to stand at. The soft fruits must be conveyed to the sorting room in shallow trays or baskets, so that they can be graded direct without turning them out. When experienced hands are employed some degree of sorting can be done at the time of gathering, thus saving further handling or removal of the fruits, and the grower will in every case endeavour to reduce this to the minimum.

Several matters have to be considered in the actual work of grading, and an intimate knowledge of the characteristics of varieties is essential to the best results. The effects of seasons on large crops also demand attention ; for the second grade of one crop might rank as the first of another. It is impossible to lay down a rule that would constitute a standard equally reliable under all conditions, but a general idea can be given of the relative values of different grades under similar circumstances.

The points of importance in classifying the best fruits are :—

(1) Freedom from injuries and blemishes. (2) Good size and even form. (3) Colour. (4) High quality with ripeness.

The first two are essential to all high-class fruits, and no defective, distorted, or undersized samples should be allowed in the leading grades of any kind.

The third quality is a special one, which always possesses a marked value in fruits for dessert, and even amongst some used for cooking or preserving, as in apples, red currants, raspberries, and strawberries, for example. A richly-coloured sample, though only of moderate size, if free from defects, will often possess a higher market value than larger and duller fruits. Cox's Orange Pippin, for instance, if sold in two grades, one large and dull or greenish-yellow, and the other a size smaller, but in its best colour, will command the larger price for the latter ; and this is true of many other fruits where colour is a characteristic that is sometimes deficient in the larger sizes.

As regards the fourth point, mere size may also be a secondary consideration, provided the fruits are choice, in perfect condition for immediate use, and free from defects. This especially concerns small packages of dessert fruits, such as the finest pears, plums of the greengage type. ripe cherries, peaches, and nectarines. A special market must be at command for such samples, or they should be sent direct to the consumers or retailers.

The bulk of fruit grading will, however, be mainly concerned with variations in size, provided the essentials of good form and freedom from defects be secured. It is of the utmost importance to ensure that each grade be as uniform

throughout as close attention can accomplish, and then the full value of the work is most likely to be obtained.

A quick eye and some practice under good guidance soon enable a packer to select the various sizes in a uniform manner. Apples in particular can be readily graded into several sizes according to the variety and the crop. Occasionally four well-marked grades may be obtained, in other instances perhaps three are secured, and sometimes only two are obtainable. The difference of a quarter of an inch in diameter will constitute a well marked grade. An American Association has adopted as the minimum standard for first grade apples of the largest types 2½ inches diameter ; while for the smaller types 2¼ inches is the minimum diameter for first grade fruits ; in each case a ¼ inch is allowed between the firsts and seconds. In practice it is found almost impossible to adhere to such exact grading ; the general standard and range in size of the crop or variety must be judged, and the graduation founded upon this. These remarks especially refer to apples for cooking, or dessert apples equally well coloured, but what has been already said about the value of colour must be remembered and a special grade selected of uniform size where there is a proportion of larger fruits deficient in that respect.

Most of the details regarding apples are also appropriate to the grading of pears, but as a larger proportion of these are used for eating than cooking, they are more adapted for disposal in small packages, and hence repay the greatest attention in uniform grading. Several qualities can usually be obtained from one crop, and it generally pays best to sell in two or three grades, only those rejected in the selecting process being disposed of in bulk. Even when large crops from old orchard trees are being dealt with, a few dozens of the finest fruits carefully packed will help to raise the total returns considerably.

Stone fruits may be selected in various grades. Plums for cooking can thus be sorted into two or three grades, the largest fruit commanding the best market. A good medium size is in demand for bottling, and the smaller sizes are utilised in ordinary cooking or preserving. Dessert plums and cherries are readily graduated on the same method, the finest in boxes or small packages and the others in bulk.

Soft fruits, such as strawberries and raspberries, are worthy of equal care, the former being sorted into at least two grades and sometimes into more. The best are placed in punnets, the next in small boxes, and a third grade can be sold in boxes or baskets holding from 6 lb. to 12 lb. Raspberries may be conveniently divided into two qualities whenever a special sale can be commanded for the best fruits either in punnets or small boxes.

Nearly all other fruits also admit of some grading, even though it be only to the extent of excluding defective and

malformed specimens; the results yield a satisfactory reward for the labour and expense.

The benefits derivable from careful and systematic grading are by no means confined to fruits, as vegetables also afford considerable encouragement to those who strive to make the most of them in the same direction. Especially is this the case with root crops, though in a general way the sorting adopted is of a very rough character. Potatoes, for example, are usually picked up in three sizes, the large tubers for sale, the seconds or sets, and the small tubers to be used as food for stock. The large size should be again sorted into two or three grades; it is with them as with apples, a comparatively small proportion of coarse irregular tubers spoils the appearance of a large consignment. Even shape and uniformity of sample possess a distinct market value, and a medium sized potato having these characteristics, together with good quality, will bring a better return than huge distorted tubers of which size is the only recommendation. If an extra 6*d.* per bushel or £1 per ton can be secured by such care it often means, with a good crop, sufficient clear gain to more than pay the expenses of cultivation.

A distinction can be made between the best or earliest turnips and carrots and the ordinary quality or crop in bulk, by marketing the former in bunches, while the latter are sent in bags or baskets. Onions, too, can be graded in several ways, the best being bunched or made into "ropes," while smaller sizes are sold loose, the smallest ranking as pickling onions. It is always advisable to have several sizes, each sample fairly uniform, as some buyers have a preference for medium sized bulbs and others for large ones. In selling small quantities by weight the retailers have a difficulty with the largest onions, and usually find the medium size more convenient. If roots are prepared for sale by being thoroughly cleaned it is a great help, and in any case wherever grading is followed all the best qualities should be so treated or the chief part of the labour will be nullified.

Peas and beans should always be graded. Yet this is seldom done by the grower, and, as with many other vegetables, it is usually left to the retailer. Large, well-filled pods of the former are always in demand, and if the colour is good their value is enhanced. But they are too often gathered without due care, and a number of insufficiently developed pods materially lower the value of the whole, while reducing future gatherings. Two or three grades of peas can be readily formed, according to the condition of the crop and the varieties, some being much more even croppers than others. In supplying consumers direct daily or at regular intervals, it is now becoming the practice to shell the peas, grade them by means of sieves, and consign to the purchaser in small boxes. Dwarf kidney beans and scarlet-

runners can be graded by selecting the long, straight, and even pods for the best samples, in smaller quantities, the bulk going for sale in bushel or half-bushel baskets.

With green vegetables, such as cabbages, savoys, kale and Brussels sprouts the principal point is to see that each sample is uniform and in the best condition, which is largely a question of care in gathering. For ordinary markets the two first named must be large and with solid hearts ; for special sale and for sending direct to consumers a smaller size, but possessing all the other essential characters, is often preferable. Brussels sprouts should always be sorted into two grades, all the firmest and most compact into one, and the looser, rougher sprouts into another ; the increased price of the first will pay for this in the majority of cases. To cauliflowers and broccoli similar remarks apply ; the most even and whitest heads constitute the first grade, the rougher and discoloured the second. As with cabbages, large heads are required in general markets, but for the best sales moderate-sized perfect samples are the most satisfactory.

Other crops pay for attention in the same way. Rhubarb can be classed in two grades, the longest, straightest and best coloured forming No. 1 bundles. Celery may be divided into two or three grades, the heaviest and most solid in bundles for salad, the others loose for soups. Asparagus, too, should be placed in two or three grades, according to the length, substance and blanching ; the smallest (Sprue) for soups ; all the best in bundles of 25, 50, or 100, the last in larger numbers. Seakale can also be sorted, the best grown and whitest in bundles set upright in baskets.

Tomatoes demand the greatest care in sorting ; two, three and even four grades may be formed. The best in boxes or shallow baskets. The most even and brightest coloured fruits take the lead ; there is a special demand for the largest handsome fruits in some markets, but the principal general sale is for good even-shaped, moderate-sized, uniform samples. Cucumbers are graded into two or three sizes ; and vegetable marrows are also sorted, but in some places large specimens of the latter are most in demand, while in others a medium size is chiefly required.

Salading, like lettuces and endive, can occasionally be separated into two grades, according to the solidity and blanching of their hearts, but as a rule a uniform sample of one value is preferable, to be regulated by the gathering.

The essential general rules in grading vegetables of all kinds are the following :—(1) Exclude all immature, over-grown, coarse, or defective specimens from the leading grades. (2) Make each grade as uniform as possible. (3) Let freshness and fitness for use be the characteristics of all vegetables when consigned to market or consumers. To aid in all this only the best varieties obtainable should be grown, and growers should watch closely for every real improvement on old sorts.

Packing for Sale.

Wherever fruits or vegetables have to be transferred a distance by road or rail, the best culture and most careful grading may lose all their value through neglectful packing. That many of the defects in market consignments are either due to this or materially increased thereby the majority of salesmen can confirm, and the complaints on this score are as frequent as those regarding inattention to grading. In dealing with fruits the essentials for success are as follows :—(1) Use only perfectly sound fruits. (2) Pack firmly, without crushing. (3) Use the best elastic odourless materials as packing. (4) Place all choice and ripe fruits in small quantities and shallow packages.

In the home trade baskets are much more extensively used than boxes, and the most common are round baskets without lids, of the bushel, half-bushel, or half-sieve types. They are strong and durable, but are objectionable for all the best fruits as, even with the most careful packing, the top layers are liable to be bruised, and under careless methods they are certain to be damaged. When apples, pears, plums, cherries, or gooseberries are sent in such baskets a covering of paper, with straw or other material, is placed on the top and secured by cross pieces of willow or hazel, the points of which are forced through the sides of the basket below the rim. Flat baskets with lids are preferable but expensive, and the difficulty with all these is that they must be charged for or returned. In extensive dealings with market salesmen baskets are supplied at very little cost to the producer, but where it is desired to promote more direct communication between the grower and retailer or consumer some other method is preferable, or the producer must provide his own baskets. It would be helpful in many districts if a local industry could be developed in cheap basket making ; there are few places where suitable willows could not be grown, and the basket making might be performed in the winter evenings. For useful information regarding willows and osiers suitable for the purpose named, see Leaflet No. 36.

Much could be said in favour of boxes for fruits, and, where only small sizes are employed, they may be purchased or made so cheaply that they can be included in the price of the fruit, and thus all the trouble of returning or collecting empties is avoided. Their more general use under the right conditions would assist producers to avoid overstocking the markets in seasons of heavy crops, and, by facilitating direct communication with the consumers, secure better prices. In a small way, boxes can be made at home at a cost of 1½*d.* to 1*s.* each ; on a larger scale, with the use of machinery, they may be turned out at about 8*s.* to 50*s.* per 100, according to the size, and boxes costing 1*d.* to 6*d.* can always be given with the

best grades of fruit, usually even with profit. Many of the leading railway companies have recognised this fact, and now supply boxes of various sizes at 1*s.* 6*d.* to 5*s.* per dozen, while several manufacturers also supply to large orders at very reasonable prices.

Various materials are available for packing purposes, but much the best are the several grades of wood wool now prepared, the coarsest being suitable for large packages and heavy fruits, and the finest softest samples for the choicest and ripe fruits. But wherever it is to be in contact even with apples and pears only the softest make should be employed; the rougher samples can be used for the bottom, or filling up at the top. All choice and delicate fruits should be encircled with bands of folded soft tissue paper, having a glazed surface, which must be in contact with the fruit. This is also required to place over the top layers, but a stronger paper is used for unripe apples or pears.

In the actual work of packing, an even layer of wood wool is placed at the bottom of the box or basket, this being covered with a sheet of paper, and upon it the fruits to be disposed of are placed firmly. The best plums, pears, or dessert apples should never be in more than two layers, and in the smallest boxes holding one layer they travel in the finest condition. If only one layer of fruits is made, the packing material at the bottom, and that at the top, besides the folded paper band round each fruit, will be all that is essential; but if there are two layers, they must be separated by two sheets of paper, and sufficient fine wood wool evenly spread to prevent injury to the lower fruits, and form a firm bed for the upper ones to rest upon. From one dozen to four dozens of the best dessert apples, pears, or plums may be so packed in one box with safety for a long journey. Peaches, nectarines, and apricots must always be in single layers, and demand the utmost care.

Strawberries can be packed in from 3 lb. to 6 lb. of selected fruits, but the first-named quantity is the best for the finest fruit, and the smallest of the railway boxes just holds that amount conveniently, allowing for a little packing material at the top and bottom. The same sized box will hold 4 lb. of best cherries, 3 lb. of raspberries without their stalks, 3 lb. red currants (closely packed), or 4 lb. of black currants; but the last two may be packed in 6 lb. to 12 lb. lots if not too ripe; the smaller quantities are, however, preferable and safer. The finest early strawberries should be packed in 1 lb. punnets, which may be either deep or shallow, round-plaited chip punnets, or square ones (with or without handles). The round punnets are best packed in trays with lids, and those generally employed will take six punnets. They are only used for the earliest and choicest fruits, when prices are good. Crates can be employed to hold several such trays, those large enough for six being a convenient size and weight.

The square punnets are packed more closely together on sliding shelves, or in trays like the others in crates. Grapes are packed in shallow or handle baskets, the points of the bunches towards the centre and the stalks secured to the sides or rims, the top of the basket being covered with stout paper tied round the rim, or some handle-baskets are fitted with lids. The sides and base of the baskets are sometimes padded, but they are then always covered with a soft glazed paper. The great point is to avoid rubbing the surfaces of the berries and spoiling the "bloom."

In every case, besides ensuring the security of the finest fruit, it should be displayed to the best advantage, and if the grade is uniform, as advised, this can be done quite honestly by the aid of a little coloured or white tissue paper to fold over the sides when the box is opened, and by arranging the fruits with the coloured side uppermost.

The question of branding or labelling must be considered, for where good fruit only is being dealt with, the use of the words "Seconds" and "Thirds" is apt to give rise to a misconception that is unfairly against the seller's interest. For the finest samples "Extra," "Select," or "Special" may be employed. Some mark the next grade A 1, and the next No. 1, or if the letter X is employed, three would be used for the first grade, two for the second, and one for the third. Another method is to term the best Selected No. 1, and the other grades Selected No. 2 and Selected No. 3. Something of this kind is needed to indicate that the lower qualities are not refuse but properly graded fruits. A grower should adopt a uniform system, and adhere to it, so that his brand may become known and have a market value, and every package ought to have the name of the variety and quality boldly printed on the label. Growers who intend to make a substantial business, and who deal honestly in the best produce, should have their own names on the packages. This is sometimes objected to in a market, but if a grower cannot make his business through the ordinary channels he must try fresh ones. It is best to endeavour to supply the shopkeepers, or to develop a trade with private customers, and send direct to them. The reduced rates at owner's risk on the railways, and the parcels post, afford ample means for enterprising men to work up a business in small packages of choice fruits if they take the trouble to do so, either by advertising, by circulars, or by trade letters.

In packing vegetables most of the general advice already given should be serviceable; but these are disposed of in larger quantities and therefore require a different class of packages. Bags of various kinds and sizes, with large light open baskets or crates, are more extensively employed than boxes. The majority of roots are sent in bags, but the best samples of turnips, carrots, &c., that are bunched are sent in crates, while radishes and small roots are sent in baskets.

Green vegetables, like cabbages, are best in crates, as also are broccoli and cauliflowers, but the earliest and best of the last named are often packed in flat baskets or hampers and pay for every care. The best samples of salading, such as lettuces, are usually packed in hampers, the rougher grades in crates. Peas and beans are packed in baskets, bushels, or half-sieves, but as previously noted peas when shelled are forwarded in small boxes containing about three quarts each. Half-sieves are also used for Brussels sprouts, pickling onions, and other small vegetables. The earliest rhubarb is consigned in hampers ; the later often goes to market in bundles loaded direct into the vans, or packed in crates, as also is celery. For all early and high quality vegetables shallow baskets or boxes are useful. Cucumbers, tomatoes, mushrooms, and many others can be conveniently sent in this way, and where periodical consignments of general vegetables are sent to private customers this is the best method. It is necessary to pack firmly as with fruits, and where green or perishable vegetables have to travel a long distance it is desirable to gather them as shortly before packing as possible, preferably in the early morning when quite fresh, but not when drenched with rain. They should not be allowed to remain exposed to sun or wind for some hours before they are sent off, as is sometimes the case, to the obvious disadvantage of the seller. Defective or decaying samples should on no account be admitted into the packages ; the uniformity so strongly recommended as regards fruits should be maintained, and it will be found that the reputation gained is a satisfactory reward for the extra care.

4, Whitehall Place, London, S.W.,
December, 1903.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Relationship of Woods to Domestic Water Supplies.

This subject has, for more than twenty years, occupied much of the attention of Forest Experimental Stations, especially in Germany, France, Austria, and Switzerland: and in view of its importance the conclusions arrived at may be usefully summarised.

It has been asserted, and theoretically the contention is doubtless correct, that masses of woodland increase the rainfall. The causes of this result are sought for in the reduction of temperature associated with forests, and in the greater absolute and relative humidity of the air in woods. But although it may be possible to obtain experimental proof by means of elaborate and long-continued observations in a region where extensive afforestation or deforestation is taking place, it may at once be said that such tree-planting as is practically possible in Britain can have no appreciable influence on the rainfall. Trees do, however, under certain conditions of the atmosphere, condense dew on their leaves and branches, and this effect may often be seen in the wet state of the ground underneath trees on a foggy morning, when the surface elsewhere is comparatively dry.

But the case is materially different where the fate of the rain and snow that falls on a tract of woodland is considered. The foliage, branches, and stems of the trees intercept much of the rain and snow so that it never reaches the ground at all, the amount so intercepted usually ranging from 30 to 45 per cent. of the total, but much depends on the character of the rainfall, and on the species of tree. In a district of heavy annual rainfall a smaller proportion of the precipitations is caught by and evaporated from the trees than where the rainfall is light. Similarly in the case of heavy and long-continued rain, as contrasted with gentle showers; in the latter case, in fact, but little of the water reaches the ground through the leafy canopy of a dense forest. Then again much depends on the kind of tree, evergreens intercepting more water throughout a year than deciduous trees,

and a larger proportion of the rainfall is evaporated from the leaves and branches in summer than in winter.

But although less rain-water reaches the soil of a wood than finds its way to the ground in the open country, the moisture in the soil is much better conserved in the former than in the latter case. Long-continued observations have shown that more water drains from a wooded area than from one devoid of trees. The greater abundance of water in forest soil, in spite of the trees intercepting a large proportion of the rain-fall, is due partly to the reduction of evaporation owing to the exclusion of the sun's rays by the foliage, partly to the air in a forest being more humid, and thus better fitted to discourage evaporation, and partly to the absorbent and retentive character of the decaying vegetable matter that covers the ground of a dense and well managed wood. The lace-work of tree roots, too, that occupy the soil of a forest, offers mechanical resistance to the rapid surface-flow of water. It is also to be noted that roots penetrate to great depths, and when they die they leave holes through which water readily penetrates from the surface. The friable condition of the soil of a wood, too, permits ready percolation of water, whereas in the open country the denser character of the surface of the ground is less favourable to the entrance of water. The consequence is that streams in a wooded country are not so subject to rapid rises and falls, the flow being maintained more equably throughout the year. Where water supply for domestic or industrial purposes is concerned, the avoidance of violent freshets on the one hand, and scanty flow on the other, is alike desirable. Not only may the water of sudden and heavy floods be lost owing to the incapacity of the reservoir to contain it, but such floods have also the disadvantage of carrying much mud and similar material in suspension, and this gradually silts up reservoirs, besides entailing increased expenditure in filtering.

It may be pointed out that the water of a reservoir surrounded by well stocked woodland is not subjected to the same amount of violent agitation during gales as is the case when such sheltering agency is absent. The mud and silt deposited on the bottom, and especially along the margin, is consequently left comparatively undisturbed, with corresponding advantages in the matter of purity.

When a catchment area is covered with trees, and with the vegetable matter that accumulates on the surface of the ground, the water that reaches the soil as rain is impeded in its flow, and its evaporation is hindered, so that the general effect is equivalent to an increase in the size of the reservoir. It is also important to note that snow melts more slowly underneath trees than in the open country, so that at a time of thaw the snow-water is yielded up more gradually. Nor must the fact be overlooked that when snow in a

forest melts, the ground absorbs the water to a much greater extent than happens in the open country. In the latter case the ground is probably frostbound, so that the snow-water cannot be absorbed by the soil, whereas forest soil, being protected by trees, never freezes to the same extent, and is consequently in a better position to absorb snow-water. The result is that not only does a forest mitigate the violence of floods, but the snow water that flows from its area is less muddy than would otherwise be the case.

Forests not only affect the degree of moisture in soil, but they also exert considerable influence on the soil temperature. Although this influence is greatest at the surface of the ground, it is also perceptible to a depth of several feet. On the average of a large number of continental stations it was found that woods of various species and ages depressed the mean annual temperature at the surface of the ground by about 2·6° F., while even at the depth of four feet the reduction of temperature was 2°.

This general cooling influence is due to a variety of causes. The foliage of the trees excludes the sun's rays, the decaying vegetable matter that covers the ground prevents the free exchange of air between the soil and the atmosphere, while the water in the soil absorbs much heat without its temperature being much affected.

While woods have a depressing influence on the mean annual temperature, it is found that this effect is usually confined to the period of summer. On the average of 11 German stations the July temperature of the surface soil in the forest was found to be 7° F. lower than that in the open field, whereas in December the former was rather warmer than the latter. Forests, therefore, tend to equalise the temperature of water collected in them, the temperature being slightly raised in winter, and markedly reduced in summer. This result would appear to be of considerable practical and hygienic importance where a supply of water for domestic purposes is concerned.

To the credit of forests is also to be placed the fact that they exercise a purifying influence both on the air and on the soil, germs of all kinds being markedly scarcer in a well-wooded district than in a similar extent of tree-less country.

4 Whitehall Place, London, S.W.,
January, 1904.

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BOARD OF AGRICULTURE AND FISHERIES.

Pig Breeding and Feeding.

To manufacture a first class carcase of pork from an ill-formed badly-bred pig is almost as difficult as "to make a silk purse out of a sow's ear." The selection of the parents of the castrated boars and spayed sow pigs which are to be fattened is, therefore, of vast importance. Where possible, it is best to obtain the service of a pure-bred boar, which should be of good quality and of a quiet disposition, fine in bone and hair, lengthy and deep in back and hind quarters, and with a comparatively light fore end. The brood sow should possess as many of the above points as possible, with at least twelve teats, placed as nearly as possible equi-distant from each other and commencing close behind the forelegs of the sow.

Many persons consider that the purity of breed of the sow is not so important, but, as with the boar, pig breeders cannot be too strongly urged to keep for breeding only those young pigs which are the produce of prolific, good tempered, and free suckling sows. Far too little attention is frequently paid to these three most important points. Old pig keepers have observed that the produce of sows that farrow large litters of even sized pigs fatten more quickly and require less food for a given increase in weight; and it is also a fact that the produce of the more lusty and muscular sows, which are usually in good condition, are better growers and thrivers than the pigs of smaller litters from weakly and delicate sows. Matured sows will produce a greater number of pigs, which are often more thrifty in many ways, than will the young sows which are too early mated with the boar.

It should be remembered also that sows continue to produce good pigs for several litters. Considerable attention is at the present time being given to the system which is common in some of the northern counties of rearing but one litter of pigs and then fattening the sow. One of the reasons given for this plan is that the young sow when fattened will take the place of a fat castrated male or a spayed female pig, and thus realise more per pound than would an aged sow when fattened; also that in these districts the majority of the pigs are fattened within a certain few months, and, therefore, it would not pay to keep the older sows to produce only one litter per

year. Neither of these reasons appears to have much force, since it is generally acknowledged that the most successful pig feeder is the one who has fat pigs to sell at all periods of the year, but particularly in months when the highest prices are obtainable for pork.

The system of killing off all the young sows also makes it impossible to improve one's stock of pigs by reserving the future breeding stock from the litters of the sows which have proved themselves to be superior milking sows and the most prolific. These are two qualities which are of the greatest importance, but which can only be discovered by the actual results of two or three litters from each sow. The continued selection by certain breeders of the best pigs from such sows has rendered their pigs superior to those in any part of the world.

There exists considerable difference of opinion as to the type or style of pig most generally profitable. The first point to be considered is the market which the pig breeder proposes to supply; in some districts near London and some other large towns the chief demand is for pigs of some four to five months old and weighing about 60 lbs. dead weight, or some 85 to 90 lbs. alive. The Middle White Yorkshire sow is much kept, and crossed either with a boar of the same breed or a Berkshire; some persons prefer to cross the other way, but the pigs from the Middle White sow are generally more numerous and grow faster when young. Many hundreds of this type of fat pig are now being weekly imported from Holland and Belgium for the London market, the Middle White boar being used on the larger native sows and the Large White boar on the more compact sows. There appears to be no sufficient reason for our pig breeders neglecting this profitable trade.

The form and weight of the fat pigs required in other districts varies from the so-called bacon curers' pigs of some 160 lbs. dead weight to the 220 lbs. to 300 lbs. somewhat fat pig most in demand in parts of Yorkshire, Lancashire, and other counties. Very much the same type of pig is needed to furnish both classes of fat pigs. The finer quality Large White is the more general favourite, but in some districts the Berkshire and the Tamworth pigs, both pure and crossed, and the Large Black pigs of the two different types which are to be found in Cornwall and Essex, are preferred.

The term of life of the fat pig should also be so short that the climate cannot materially affect its growth and thrift, or, in other words, the life of the pig should consist of only one part, the fattening period, not, as is far too frequently the case, a long store period, to be followed later on by a more or less long time in being fattened. An enormous loss is sustained by the adoption of the second system, as, after the pig has arrived at some three months old, the cost of producing a pound of meat from it will gradually increase, so that a loss

results after a few months. The cause of this is not far to seek; the young and growing pig can and does utilise all the properties of the food, so that the growing and feeding progress simultaneously, whilst the older and store pig really needs only those properties of the food which are required to fatten it, so that the other properties not utilised are simply wasted. Besides this a certain quantity of food is required simply for its upkeep, so that if the pig lives only a month longer than is absolutely necessary the value of this amount of food is thrown away.

The best system of management of sows and young pigs varies with the district. There is often a considerable quantity of available food which costs little, be it odds and ends from the garden and the house in the country, or from hotels or public institutions wherever they may be found. In many, if not in most, instances, the sow may be kept at little expense during the three months after her pigs are weaned—a run in a paddock or grass field during the spring and summer will be well nigh sufficient; then, when the grass loses its quality, or becomes less in quantity, the addition of a few soaked maize, or peas or beans when prices admit of it, or even roots of almost any kind given raw—potatoes only being steamed or boiled—will suffice. Even the kitchen refuse from fair sized houses will go far towards the keeping of the brood sow. During the latter stage of pregnancy the sow must be fed on more nourishing diet, since the drain on a sow is very considerable in the production of a good litter.

In the majority of cases the farrowing sow needs but little help. So few of the ordinary sows kept are accustomed to the owner or attendant taking much notice of them that they will probably resent the offers of help when the pain and excitement attending farrowing render the sows more sensitive and nervous. There may be times when a little help is needed, as when one of the little pigs is presented doubled up, as sometimes occurs; then the attendant's hand should be well greased and carefully inserted, so that the pig be returned into the womb, when it will most probably be rightly presented and brought into the world. Again, piglings which are of abnormal size from any cause sometimes give the sow considerable trouble to eject. If the sow be perfectly quiet, help can be given with profit by the attendant, care being taken not to use too much force so that the sow is not internally injured.

After the sow has finished farrowing, a small quantity of warm and sloppy food should be given to her, and if the bed be very wet, a small quantity of short straw should be given to her, when she will lie down and rest for several hours until her pigs are quite strong, providing they do not quarrel over the selection of their own particular teats; if they should bite the sow's udder, the little sharp teeth should be broken off with a pair of pincers. Those pigs which are carried more than the usual sixteen weeks frequently have

long and sharp, and sometimes dark coloured, teeth, which are very sharp ; to break these off is a necessity. The sow will usually show that the pigs' teeth require attention, as she will lie on her belly and refuse to suckle them ; if this be continued for any length of time the collection of milk will cause inflammation of the udder, with disastrous results.

When the pigs are about a month old they will commence to eat some of the sharps fed to the sow ; it is then a good plan to turn the sow out of the sty for an hour or two, and to give the little pigs a few peas or kernels of wheat to eat. Many persons make the mistake of only feeding the freshly weaned pigs twice a day, forgetful of the fact that the sow suckles her pigs from eight to twelve times a day, as they grow older. Their stomachs are not intended to stow away large lots of food at a time.

A very considerable number of carcases of tuberculosed pigs have of late been sent to the London markets for sale as human food, and many persons have been prosecuted on this charge, and in some cases heavily fined. Pig breeders and feeders are cautioned therefore against the risk of prosecution which they incur by disposing of such tuberculous carcases. Tuberculosis is by no means uncommon in pigs, and is probably chiefly caused by feeding them on diseased offal from cattle which have died of the disease, the parts most commonly affected being the lungs. Especial care should therefore be taken to prevent swine from coming into contact with any parts of the internal organs of diseased cattle. Such parts should be buried or burned. Pigs are also liable to contract the disease if fed upon milk drawn from a cow affected with tuberculosis of the udder. When a cow has one or more hard quarters, therefore, the milk should not be fed to the pigs unless it be first boiled.

The indications of tuberculosis in the pig consist mainly of hard swellings around the throat and the presence of white cheesy-looking deposits of tubercular material within or upon the intestines or the lungs. In the event of either of these conditions being found after death, the owner should not send the carcase to market without ascertaining from the Sanitary Inspector of his district or from his Veterinary Surgeon that the carcase is free from tubercular disease.

4, Whitehall Place, London, S.W.,
January, 1904.
Revised July, 1904.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

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